



**Pacific Gas and
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Company**

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March 30, 2020

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Subject: Transmittal of the *Four-Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)*, Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Dear Ms. Zimmerman, Ms. Lopez, and Ms. Barker:

Enclosed is the *Four-Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)*, Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California (report). The report is being submitted to comply with California Regional Water Quality Control Board, Lahontan Region (Water Board) Cleanup and Abatement Order No. R6V-2015-0068 issued on November 4, 2015 (2015 CAO; Water Board 2015). The report evaluates the effectiveness of remedy components that have been implemented towards reaching remedial targets and recommends improvements for remedy performance. Additionally, the report includes an operational plan for 2020.

Over the last 4 years, we have aggressively worked to improve and adjust the remedy. During this time, more than double the amount of planned remedial infrastructure was proactively constructed and operated to keep the remedy progressing toward the CAO remedial goals. The additional remedial infrastructure includes 73 remedial wells that have been installed since 2015 compared to the 35 that were planned in the Remedial Timeframe Assessment (Arcadis 2014).

Significant progress at the site can be grouped into four broad areas:

- Validating the remedy approach: Years of data and an updated evaluation of best available technologies (BAT) confirmed that the current technologies of in-situ treatment, groundwater extraction with treatment at Agricultural Treatment Units (ATUs), and freshwater injection are appropriate. Importantly, this approach provides for beneficial use of extracted water and is also resulting in a reduction of legacy nitrate impacts to groundwater.
- Understanding plume conditions: Our understanding of the plume and the local geology has significantly changed in three ways. First, proactive investigations identified additional core areas with high concentrations of hexavalent chromium. This characterization was a key step toward designing and implementing remedy enhancements to treat these high-concentration areas in order to meet the 10- and 50-microgram per liter (µg/L) goals. Second, a study of the Lockhart Fault System by Dave Miller at the United States Geological Survey (as part of the background study), has shown that there are numerous fault splays present throughout the southern plume area (Miller et al. 2018). The hydrogeologic influences of these newly identified fault splays within

Ms. Zimmerman
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the plume core areas, which contain the highest chromium concentrations on site, are just beginning to be understood. Finally, we have been able to document and better understand the impacts of the drought, which has resulted in declining water levels in the greater Centro Area of the Mojave River basin.

- Chromium mass removal: Performance data collected over the last 4 years demonstrate considerable progress toward reducing chromium concentrations and removing chromium mass, which is foundational to any effective remediation. Mass removal estimates show that approximately three times more mass (74%) has been removed from groundwater by remediation since 1992 compared to what remains (26%) in groundwater.
- Shrinking the plume: The 10 and 50 µg/L plume areas are shrinking from the outside rapidly in the north, with a retreat of the 50 µg/L contour by approximately 2,800 feet from the north and a retreat of the 10 µg/L contour by approximately 1,550 feet from the north and approximately 2,500 feet from the west. In the south, the treatment is carving holes in the plume from the inside, resulting in a steady decline in plume area.

Together, the actual performance and modeling prediction updates demonstrate considerable progress toward reaching 2015 CAO deadlines and show that the remedy is on the right track. However, there is uncertainty associated with areas of elevated chromium concentrations that were not known in 2015, areas that may be influenced by the complexity of the newly identified fault splays, areas of slow performance that may take time beyond the 2025 deadline to reduce concentrations down to 50 µg/L and areas where remediation is on hold for permitting revisions. Accordingly, a workplan will be submitted by April 29, 2020 proposing recommendations and an implementation schedule to build upon the infrastructure that has already been added to the RTA design to improve remedy effectiveness. Several of these enhancements are identified throughout the report. We are happy to report that, after several years of effort, we have obtained the necessary biological permits from the relevant state and federal agencies to complete the last of these enhancements. We look forward to completing the permitting process with the Water Board in order to get these enhancements installed.

These changes, in conjunction with the extra remedy infrastructure installed to date, are expected to contribute to continuing the ongoing steady progress toward achieving the CAO goals of 50 µg/L across 90% of the chromium plume by 2025 and 10 µg/L across 80% of the chromium plume by 2032. However, it is possible that the 50 µg/L goal will be reached after 2025, even with these enhancements.

Please call me at (415) 314-8530 if you have any questions regarding the enclosed report.

Sincerely,



Iain Baker

Copies:
Patrice Copeland

Enclosure: *Four-Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019), Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California*

Ms. Zimmerman
Ms. Lopez
Ms. Barker
March 30, 2020

References:

Arcadis. 2014. Remedial Timeframe Assessment. PG&E Compressor Station, Hinkley, California. June 30.

Water Board. 2015. Cleanup and Abatement Order No. R6V-2015-0068 WDID No. 6B369107001 Requiring Pacific Gas and Electric Company to Clean Up and Abate Waste Discharges of Total and Hexavalent Chromium to the Groundwaters of the Mojave Hydrologic Unit. November 4.

Miller D.M., Haddon, E.K., Langenheim, V.E., Cyr, A.J., Wan, E. Walkup, L.C., and S.W. Staratt. 2018. Middle Pleistocene infill of Hinkley Valley by Mojave River sediment and associated lake sediment: Depositional architecture and deformation by strike-slip faults. Against the Current: The Mojave River from Sink to Source. 2018 Desert Symposium Field Guide and Proceedings. April. Available at:
<http://www.desertsymposium.org/2018%20DS%20Against%20the%20Current.pdf>

Pacific Gas and Electric Company

FOUR-YEAR COMPREHENSIVE CLEANUP STATUS AND EFFECTIVENESS REPORT (2016 TO 2019)

Hinkley Compressor Station
Hinkley California

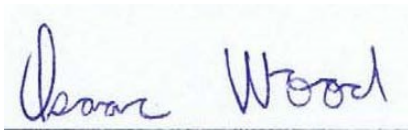
Cleanup and Abatement Order
No. R6V-2015-0068

March 30, 2020

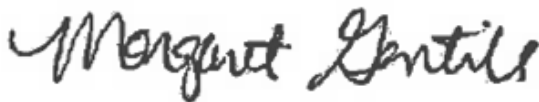
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FOUR-YEAR COMPREHENSIVE CLEANUP STATUS AND EFFECTIVENESS REPORT (2016 TO 2019)

Hinkley Compressor Station Hinkley
California Cleanup And Abatement
Order No. R6V-2015-0068



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March 30, 2020

Executive Summary

This Four-Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019; report) provides a comprehensive evaluation of chromium cleanup actions at the Pacific Gas and Electric Company (PG&E) Hinkley Compressor Station (the site) to reach target concentrations listed in the Cleanup and Abatement Order No. R6V-2015-0068, issued on November 4, 2015 (2015 CAO; California Regional Water Quality Control Board, Lahontan Region [Water Board] 2015).

The 2015 CAO established cleanup requirements for the site, including the following cleanup timeframes for the southern plume in Requirement VI:

- Reach and maintain 50 parts per billion (ppb, equivalent to micrograms per liter [$\mu\text{g/L}$]) hexavalent chromium (Cr(VI)) and total chromium (Cr(T)) in 90% of the 50 ppb Cr(VI) plume as of the date of the 2015 CAO by December 31, 2025, as determined by a specified set of monitoring wells.
- Reach and maintain 10 ppb Cr(VI) and Cr(T) in 80% of the 10 ppb Cr(VI) plume as of the date of the 2015 CAO by December 31, 2032, as determined by a specified set of monitoring wells.

In 2014, Arcadis U.S., Inc. (Arcadis) conducted a Remedial Timeframe Assessment (RTA; Arcadis 2014) that estimated remedial timeframes based on a preliminary design of remedial infrastructure and a preliminary plan of construction sequencing and operations. The estimated timeframes from the RTA informed the cleanup timelines adopted in the 2015 CAO, although the deadlines established in the 2015 CAO are sooner than the range of estimates identified in the RTA.

Over the last four years, an adaptive management approach has been implemented, and more than double the amount of planned remedial infrastructure was proactively constructed and operated to keep the remedy progressing toward the 2015 CAO remedial goals. The additional remedial infrastructure includes 73 remedial wells that have been installed since 2015 in comparison to the 35 that were planned in the RTA. Exhibit ES-1 below summarizes key construction activities, effectiveness evaluations, and recommendations for improvements from observations made over the past four years (2016 through 2019). Significant remedial progress has been made at the site in several key areas: validating remedy selection and design methodology, understanding plume conditions, removing mass from groundwater, and reducing the aerial extent of the plume. Advancements in each of these areas are necessary and work in concert to progress the project toward reaching the target concentrations in CAO Requirement VI (Water Board 2015).

Performance data are continuously reviewed as part of a feedback loop to inform daily system operations. The performance evaluations have validated remedy applicability, improved the remedy design through refinement of well spacing, and advanced optimization of the extraction system for plume control and contraction. An updated evaluation of Best Available Technologies required for this four-year assessment confirmed that the combination of current technologies of in situ treatment, groundwater extraction with treatment at Agricultural Treatment Units (ATUs), and freshwater injection continues to comprise an expeditious approach to achieving the 2015 CAO goals, while providing for beneficial use of extracted water that is resulting in a reduction of legacy nitrate impacts to groundwater.

Proactive investigations advanced the understanding of plume conditions through the identification of high Cr(VI) concentration areas. This characterization was a key first step toward designing and implementing remedy enhancements to progress treatment of these high concentration areas to meet the 10 and 50 $\mu\text{g/L}$ goals. In addition, an improved understanding of the Lockhart Fault system was revealed in a study by Dave Miller at the United States Geological Survey (USGS) as part of the chromium background study.

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The USGS study indicates that there are numerous splays of the Lockhart Fault present throughout the southern plume area (Miller et al., 2018). The hydrogeologic influences of these newly identified fault splays within the plume core areas, containing the highest chromium concentrations on site, are just beginning to be understood.

Performance data collected over the last four years demonstrate significant progress toward reducing concentrations, removing mass, and reducing aerial extent of the plume. Mass removal estimates show that approximately three times more mass (74%) has been removed from groundwater by remediation since 1992 in comparison to what remains (26%) in groundwater¹. The 10 and the 50 µg/L plume areas are shrinking from the outside rapidly in the north, with a retreat of the 50 µg/L contour by approximately 2,800 feet from the north and a retreat of the 10 µg/L contour by approximately 1,550 feet from the north and approximately 2,500 feet from the west. In the south, the treatment is carving holes in the plume from the inside, resulting in a steady decline in plume area.

Together, the actual performance and modeling prediction updates demonstrate considerable progress toward reaching 2015 CAO deadlines and show that the remedy is on the right track, but there is uncertainty associated with areas of elevated concentrations that were not known in 2015, areas that may be influenced by the complexity of the newly identified fault splays, areas of slow performance that may take time beyond the 2025 deadline to treat to 50 µg/L, and areas where remediation is on hold for permitting revisions. Accordingly, a workplan will be submitted by April 29, 2020 proposing recommendations and an implementation schedule to build on the infrastructure that has already been added to the RTA design to improve effectiveness. Several of these enhancements are identified throughout this report. These changes, in conjunction with the extra remedy infrastructure installed to date, are expected to significantly advance and maintain the current steady progress toward achieving the CAO goals of 50 µg/L across 90% of the plume by 2025 and 10 µg/L across 80% of the plume by 2032. However, it is possible that the 50 mg/L goal will be reached after 2025, even with the planned enhancements.

Due to the lack of Mojave River flows and limited Lenwood Recharge Basin imports in recent years, groundwater levels in the Hinkley Valley and greater area have generally shown a steady decline since 2011 when the last significant Mojave River flows occurred. Drought conditions and declining water levels persisted through the winter of 2019/2020, despite a single short-duration, low-volume river flow event on February 16, 2019 and the application of water to the Lenwood Recharge Basin in 2019.

Throughout the reporting period, hydraulic control has been maintained through adaptive management despite the persistence of drought conditions. In the northern portion of the southern plume, the northern extraction and ATUs maintained hydraulic control with optimization occurring many years ahead of plan. In the southern portion of the southern plume, the southern extraction and ATUs maintained hydraulic control, and capture was enhanced by bringing eight extraction wells online in the last two years along the eastern plume boundary. These extraction wells were installed to adapt operations in response to declining groundwater levels due to drought conditions and have resulted in reduced Cr(VI) concentrations observed in 2018 and 2019 at several plume boundary wells.

¹ Mass calculations are estimates and require assumptions to complete. Details on the assumptions, including Cr(VI) data used and assumptions related to saturated thickness under drought conditions, and procedures used to estimate mass removal estimates are provided in Appendix B.

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The changes to sampling frequencies under 2015 CAO requirements I.C and I.D in 2020 included decreased sampling frequency in 25 wells and increased sampling frequency in 14 wells. During 2019, remedial systems were generally operated according to the 84 monthly goals set forth in the 2019 operational plan (Arcadis 2019), with two very minor exceptions: in March and April 2019 when the southern ATUs were operated at less than planned rates to prevent overwatering and ponding. These minor exceptions did not impact system performance.

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Exhibit ES-1 2016 to 2020 Remedy Summary

Remedial System/ Area	Were Plans for 2016 – 2019 Construction Implemented? ¹	Additional Construction Activities ²	System Effectiveness	Component of Forthcoming Action Plan
Hydraulic Containment North	Yes	Yes <ul style="list-style-type: none"> • 2 additional extraction wells 	Effective <ul style="list-style-type: none"> • Optimization ahead of plan • Successful containment • Significant plume contraction • Western operations optimized 	No
Hydraulic Containment South	Yes	Yes <ul style="list-style-type: none"> • 2 extraction wells south of Community Boulevard in the Southeastern Source Area • 6 extraction wells East of Community East ATU 	Effective <ul style="list-style-type: none"> • Hydraulic control of plume was maintained under changing drought conditions with the addition of 8 new extraction wells. • Concentration reductions observed at several plume boundary wells in response to new extraction wells 	No
Lower Aquifer	Not applicable	Not applicable	Effective <ul style="list-style-type: none"> • Significant reductions in concentrations • Mass remains in relatively small area (two wells) with complex geology, pilot test planned 	No
Central Area IRZ	Not applicable	Not Applicable	Effective, with recommendations <ul style="list-style-type: none"> • Eastern and central portions progressing, with exception of far east extent • Existing infrastructure does not effectively target the far western extent of the IRZ 	Yes <ul style="list-style-type: none"> • Expand the remedial system to the west following approval of Notice of Applicability (NOA) modifications • Evaluate remedy enhancements to the far east
SCRIA IRZ	Yes	Yes <ul style="list-style-type: none"> • 21 additional injection wells • 3 additional extraction wells 	Effective, with recommendations <ul style="list-style-type: none"> • Improvement in areas of new operations • Modeling results indicate additional infrastructure needed to target Cr(VI) in western extent 	Yes <ul style="list-style-type: none"> • Expand to the remedial system to the west following approval of NOA modifications
Source Area IRZ	Yes	Yes <ul style="list-style-type: none"> • 4 additional injection wells 	Effective, with recommendations <ul style="list-style-type: none"> • Cr(VI) concentrations have declined across the Source Area in IRZ treatment areas • Modeling indicates additional infrastructure needed to address remaining mass in the northern Source Area 	Yes <ul style="list-style-type: none"> • Characterize plume extent and develop strategy to address elevated Cr(VI) concentrations in the northern Source Area

Notes:

¹ 2016-2019 construction plan as presented in Arcadis 2016, 2017, 2018, and 2019.

² Construction activities in addition to those in Arcadis 2014 Remedial Timeframe Assessment (Arcadis 2014).

FOUR-YEAR COMPREHENSIVE CLEANUP STATUS AND EFFECTIVENESS REPORT (2016 TO 2019)

References

- Arcadis. 2014. Remedial Timeframe Assessment, PG&E Hinkley Compressor Station, Hinkley, California. June 30.
- Arcadis. 2016. Annual Cleanup Status and Effectiveness Report (January to December 2017), Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California. February 28.
- Arcadis. 2017. Annual Cleanup Status and Effectiveness Report (January to December 2017), Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California. February 26.
- Arcadis. 2018. Annual Cleanup Status and Effectiveness Report (January to December 2017), Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California. February 28.
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ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
2015 CAO	Cleanup and Abatement Order No. R6V-2015-0068, issued November 4, 2015
2017 Annual Report	2017 Annual Cleanup Status and Effectiveness Report
2018 Southeastern Area Workplan	Workplan for Investigation of Increasing Southeastern Area Chromium Concentrations and Associated Remedial Actions
Arcadis	Arcadis U.S., Inc.
ATU	Agricultural Treatment Unit
BAT	Best Available Technology
BOD	Basis of Design
CDFW	California Department of Fish and Wildlife
CH2M	CH2M HILL, Inc.
Cr(III)	trivalent chromium
Cr(T)	total chromium
Cr(VI)	hexavalent chromium
DVD	Desert View Dairy
FS	Feasibility Study
gpm	gallons per minute
HCP	Habitat Conservation Plan
IRZ	In Situ Reactive Zone
ITP	Incidental Take Permit
Lower Aquifer CSM Report	Updated Conceptual Site Model and Background Chromium Concentrations for Lower Aquifer Report
LTU	Land Treatment Unit
MCL	maximum contaminant level
mg/L	milligrams per liter
MRP	Monitoring and Reporting Program
NATU	Northern Agricultural Treatment Unit
NOA	Notice of Applicability
NWFI	Northwest Freshwater Injection
PG&E	Pacific Gas and Electric Company
ppb	parts per billion
report	Four-Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
RCF	Reduction, Coagulation, and Filtration
RF-Sn(II)	reduction/filtration by stannous tin

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RTA	Remedial Timeframe Assessment
SATU	Southern Agricultural Treatment Unit
SCRIA	South Central Reinjection Area
site	Hinkley Compression Station located in Hinkley, California
TOC	total organic carbon
USFWS	U.S. Fish & Wildlife Service
WAE	Western Area extraction
WCB	Western Community Boulevard
Water Board	California Regional Water Quality Control Board, Lahontan Region
Western Action Plan	Revised Action Plan Required by Request for an Action Plan and More Information in Reports Required by Cleanup and Abatement Order No. R6V-2008-0002 and Investigative Order No. R6V-2013-0041

1 INTRODUCTION

Pacific Gas and Electric Company (PG&E) is submitting this Four-Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019; report) to comply with California Regional Water Quality Control Board, Lahontan Region (Water Board) Cleanup and Abatement Order No. R6V-2015-0068, issued November 4, 2015 (2015 CAO; Water Board 2015), for the Hinkley Compression Station located in Hinkley, California (the site). This report evaluates the effectiveness of remedy components that have been implemented towards reaching remedial targets and recommends improvements for remedy performance, as specified in the 2015 CAO for the four-year period including 2016 through 2019. Additionally, this report includes an operational plan for 2020.

The 2015 CAO established the following cleanup requirements for the site, including cleanup timeframes for the southern plume in Requirement VI:

- Reach and maintain 50 parts per billion (ppb, equivalent to micrograms per liter [$\mu\text{g/L}$]) hexavalent chromium (Cr[VI]) and total chromium (Cr[T]) in 90% of the 50 ppb Cr(VI) plume as of the date of the 2015 CAO by December 31, 2025, as determined by a specified set of monitoring wells.
- Reach and maintain 10 ppb Cr(VI) and Cr(T) in 80% of the 10 ppb Cr(VI) plume as of the date of the 2015 CAO by December 31, 2032, as determined by a specified set of monitoring wells.

Cleanup timeframes under various remedial scenarios were first estimated in the 2010 Feasibility Study (FS; Haley and Aldrich 2010) and addenda (Haley and Aldrich 2011a, 2011b, 2011c). The FS and addenda identified strategies for implementing site cleanup and for achieving background concentrations of chromium, including timeframe estimates for achieving various cleanup milestones. In the Remedial Timeframe Assessment (RTA), dated June 30, 2014 (Arcadis U.S., Inc. [Arcadis] 2014), PG&E updated the groundwater flow and solute transport computer model used in the FS based on current concentration data and experience at the site with remedial implementation to date. The RTA modeling was based on a preliminary design of remedial infrastructure and a preliminary plan of construction sequencing and operations. The solute transport modeled cleanup timeframe ranges, included in the 2014 RTA, reflect remediation timeframe ranges for different hydrostratigraphic layers of the Upper Aquifer and different assumptions of in situ remediation degradation rates.

The estimated timeframes from the RTA informed the cleanup timelines incorporated into the 2015 CAO listed above, although the exact deadlines in the 2015 CAO are sooner than the range of estimates provided in the RTA. This report fulfills the requirements for annual effectiveness evaluation reports as well as the requirements for a four-year comprehensive evaluation as required in the Monitoring and Reporting Program (MRP) of the CAO as follows:

- Section 2 describes remedial implementation versus plan for the last four years.
- Section 3 provides a comprehensive evaluation of remedial actions toward reaching CAO targets including an evaluation of Best Available Technologies (BATs) and an updated groundwater modeling predictions informed by the last four years of data as required for four-year reports.
- Section 4 of the report provides an overview of persistent drought conditions that can potentially affect remedial progress.

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- Sections 5 and 6 provide the more detailed analysis of remedial effectiveness and recommendations required every year, but summarized for the entire four-year period, with Section 5 focusing on the hydraulic control systems and Section 6 covering remediation of the plume core with In Situ Reactive Zone (IRZ) operations.
- The annually required sampling frequency is provided in Section 7.
- The annual operational plan for the next year is provided in Section 8.
- Section 9 provides a list of references cited in the text.

2 REMEDY IMPLEMENTATION TO DATE AND PLANNED ACTIVITIES

This section summarizes remedial actions conducted to date, the schedule for remedial expansion, and remedy construction compared to the long-term plans.

2.1 Summary of Remedial Operations to Date

Since 1992, PG&E has been actively remediating chromium-impacted groundwater at the site through a series of interim remedial actions (Table 2-1 and Figures 2-1 and 2-2). Initial remedial activities (1992 through 2001) included groundwater extraction from up to 32 wells completed in the Upper Aquifer. Extracted groundwater was used to support agricultural operations at the East and Ranch Land Treatment Units (LTUs; Table 2-1). In 2004, PG&E began operation of the Desert View Dairy (DVD) LTU and several key remediation components including the IRZ systems, which began at a larger scale in late 2007. Agricultural Treatment Units (ATUs) and additional hydraulic containment infrastructure followed in subsequent years. These systems continued to be expanded and/or operated through December 2019 as follows:

- Hydraulic containment and Cr(VI) mass removal through operation of a system of more than 60 groundwater extraction wells and a freshwater injection system
- Agricultural operations and beneficial use of extracted groundwater for irrigation of between 256 and 306 acres of farmland to remove chromium from irrigation groundwater within the root zone of fodder crops
- In situ treatment of chromium through operation of IRZs with 135 remediation wells spanning an approximate area of 0.5 mile by 1 mile where the highest chromium concentrations were present.

Figure 2-1 shows the locations of remedial action areas. Figure 2-2 presents a timeline of remedial action operations. Table 2-1 summarizes the chronology of remediation system startup dates, the numbers of monitoring and extraction wells, and combined extraction rates. Table 2-1 also shows increases in the number of wells over time for the various remedial systems.

2.2 Remedial Timeframe Assessment Long-Term Plans for Comprehensive Remediation of the Southern Plume

The RTA (Arcadis 2014) provided a preliminary construction sequencing and operational plan for new remedy infrastructure design to address chromium concentrations in the southern plume, identified as the area just north of Thompson Road to the Hinkley Compressor Station (Figure 2-1). The plan in the RTA has generally been followed as the remedy has progressed over the last four years. However, information gathered through implementation of remedial systems and investigations is used to inform and refine the plans for remedy infrastructure and operations, employing an adaptive management approach. Figure 2-3 presents the remedial infrastructure constructed from 2015 through 2019, following the RTA. Infrastructure constructed following the general plan in the RTA is shown in pink on Figure 2-3. In many cases, remedial infrastructure has been added beyond what was planned in the RTA (as shown

in green on Figure 2-3) or ahead of the schedule in the RTA as part of adaptive management. In a few cases, infrastructure installation has deviated from the RTA; for example, where permits were not received according to the schedule in the RTA.

The RTA operational plan envisioned the following remedial expansions and modifications over time (Arcadis 2014), as shown on Figure 2-4. Table 2-2 summarizes remedy construction since the RTA from 2015 through 2019, noting where actual designs varied from RTA assumptions and where projects and wells were added beyond the assumptions in 2019. The following provides an overview of remedy construction since 2015 versus the RTA assumptions, while the subsequent section provides specifics for 2019.

- **Mid- to late-2015:** New Source Area IRZ replacement wells in the north and new injection wells in the southeast South Central Reinjection Area (SCRIA) were planned be turned on. Additionally, buildout was planned to be completed, and operation of the southern Community East and Fairview ATUs was planned be initiated. These expansions and modifications were initiated before the CAO issuance in 2015 and completed by early 2016.
- **Within the first few years:** Construction of the southern Source Area IRZ and western SCRIA east of Fairview Road were planned to be completed. These components of the remedial system were completed with the Southeast Source Area project in 2017 and the SCRIA project in 2016 to 2017 (Table 2-2).
- **After approval of wildlife agency permits needed to construct in habitat, assumed to be May 2018:** IRZ injection wells in areas of biological habitat, generally to the west of Fairview Road and in the northeastern portion of the SCRIA (yellow and orange shaded areas, Figure 2-4) were planned to be built and begin operation. The western project was completed in advance of the Habitat Conservation Plan (HCP) in consultation with the wildlife agencies in 2017 to 2018, listed as the Western IRZ project in Table 2-2. The northeastern SCRIA project in habitat north of the Community East ATU is behind the RTA schedule assumption of January 2019 due to delays in wildlife agency permitting. However, the permit was issued during the First Quarter of 2020; therefore, construction in this area can now begin after the Water Board issues a revised IRZ NOA including this area.
- **After approximately 5 years (2020):** Extraction wells in the Community Boulevard area will be converted to injection wells to treat the area between Community Boulevard and the SC-IW-20 series injection wells. During the Fourth Quarter of 2019, construction was initiated to convert eight existing Western Community Boulevard extraction wells (EX-40 and EX-43 through EX-49), listed as the Western Community Boulevard Extraction/IRZ Conversion in Table 2-2. The RTA assumed that the conversion would occur in 2020; however, the conversions were implemented in the fall/winter of 2019. Given the interconnectivity to the SCRIA IRZ and relative location of the Source Area IRZ, this area will be referred to as the Western Community Boulevard (WCB) IRZ. Conversion was made ahead of plan given that extraction rates have declined as the water table has dropped, and IRZ injection into this high concentration area will begin reducing chromium concentrations. Further, the WCB extraction wells had also begun to extract treated water from upgradient IRZ operations that contains dissolved manganese and iron from biological activity resulting in injection and extraction well fouling. To limit aquifer drawdown and minimize well fouling, the WCB extraction wells were generally not in use during 2019.

- **After approximately 10 years (2025):** Optimization of the northern extraction system will begin, including the construction of up to 12 new extraction wells. Optimization began well in advance of this projection with the installation of EX-53 in 2017.

2.3 Planned and Actual Construction and Well Installations in 2019

In 2019, progress on remedy implementation continued. Remedy expansions included the addition of several systems that were not included in the RTA but rather, were identified through adaptive management to supplement remedy performance. Figure 2-5 and Table 2-2 show planned and actual design and construction of system expansions for 2019 compared to the plan for new remedy infrastructure design presented in the RTA and operations to the annual operational plans presented in the Annual Effectiveness Reports (Arcadis 2016a, 2017a, 2018d). The RTA did not include expansions or construction in 2019. Projects implemented in 2019 focused on remediation of high-concentration areas of the plume and included projects to enhance clean water flushing along the plume margins and hydraulic control of the plume in response to the drought. As shown on Figure 2-5, investigation, design, construction, and in some cases startup, for the following systems took place in 2019.

Projects Based on Design in RTA

- **Western Community Boulevard Extraction/IRZ Conversion:** During the Fourth Quarter of 2019, conversion of the eight existing WCB extraction wells (EX-40 and EX-43 through EX-49) to IRZ injection wells began (shown in green triangles on the right panel on Figure 2-5), as described in the Notification of Plan to Convert Existing Extraction Wells to IRZ Wells (Arcadis 2019d). The WCB extraction wells were mechanically redeveloped, and chemical well rehabilitations were conducted at EX-43, EX-44 and EX-45, and EX-47 through EX-49. Following rehabilitation, the existing pipelines for the eight conversion wells are being tied into existing IRZ injection and ethanol conveyance systems. Startup of a subset of these wells is planned for the First Quarter of 2020.
- **Southern Source Area (SA-RW-57):** This project continues expansion in the southern Source Area that began in 2016-2017. Investigation within the Hinkley Compressor Station was completed in 2017-2018 before design refinement. A plan for phased implementation was submitted in a design notification on October 11, 2019 (Arcadis 2019e). Within the southwestern area of the Hinkley Compressor Station, one well (SA-RW-57, shown as a blue triangle on the right hand panel of Figure 2-5) was drilled for Phase I of the expansion. Two injection wells were evaluated in the RTA. Well SA-RW-57 will first be operated as an extraction well, then later reconfigured to serve as an IRZ injection well. Construction to connect this well to the Source Area system will be completed in the first half of 2020. Additional IRZ wells may be constructed depending upon the performance of SA-RW-57 and other existing IRZ wells in treating chromium in this area.

Remedy Enhancements in High-Concentration Areas

- **Deep SCRIA East IRZ:** Two extraction wells (EX-57 and EX-58) were installed during the First Quarter of 2018 to evaluate the distribution of Cr(VI) in the central portion of the Community East ATU to inform next steps for remedial construction in this area. Depth-discrete samples from EX-57 and EX-58 indicated that elevated deep zone Cr(VI) concentrations extended further to the south. Subsequently, during the Fourth Quarter of 2018, remedial wells additional to those planned in the RTA were installed to address Cr(VI) concentrations in the deep zone of the Upper Aquifer in the

Deep SCRIA East (Arcadis 2018d). This expansion included installation of three extraction wells (EX-63, EX-64, and EX-65), five injection wells (SC-IW-60 through SC-IW-64), and three performance monitoring wells pairs (SC-MW-60S/D, SC-MW-61S/D, and SC-MW-62S/D), shown in orange extraction well symbols and pink injection well symbols on the left panel of Figure 2-5 under Community East ATU. Additionally, existing wells EX-57 and EX-58 were completed as injection wells during the First Quarter of 2019, for a total of seven injection wells. Installation of conveyance piping, including system startup and shakedown, and operation of a subset of these remedial wells was completed in the Second Quarter of 2019. This project was additional to the remedial infrastructure evaluated in the RTA (Arcadis 2014) and the 2017 Annual Report (Arcadis 2018b).

- Western IRZ Expansion:** The 2018 Annual Effectiveness Report (Arcadis 2019a) recommended expanding the Central Area and SCRIA IRZ systems to the west to address difficult-to-treat mass in the Central Area and additional mass identified in the western SCRIA. Proactive investigations in 2018 (shown as orange triangles on the west side of the IRZ system on the left side of Figure 2-5) indicated additional mass to treat in the western SCRIA. The design for this project was submitted in June 2019 (Arcadis 2019c) but was not completed due to delays in obtaining wildlife agency permits and Water Board permit revisions. The U.S. Fish and Wildlife Service (USFWS) approved the HCP and issued the Section 10 ITP in 2019. The California Department of Fish and Wildlife (CDFW) finalized and issued the Section 2081(b) Incidental Take Permit (ITP) on February 11, 2020. PG&E first discussed the revision to the IRZ Notice of Applicability (NOA) to allow the western IRZ expansion with Water Board staff in a meeting on November 27, 2018. A request to modify the IRZ NOA was subsequently submitted to Water Board staff on March 18, 2019, and a proposed modification memo was submitted by PG&E on September 20, 2019 (Arcadis 2019f). Water Board approval of the IRZ NOA revision is still pending and is further delaying construction of this project. PG&E plans to construct the additional IRZ wells as soon as possible after the Water Board issues the revised IRZ NOA to begin addressing this high-concentration area.

Hydraulic Control Enhancements

- Southeastern Plume Piezometers and Extraction Wells:** To address data gaps regarding the understanding of groundwater flow direction in the east and southeast portions of the plume, four multi-depth piezometers (PZ-16A/B through PZ-19A/B, shown as yellow circles on the left panel of Figure 2-5) were installed during the Fourth Quarter of 2018 as described in the Workplan for Investigation of Increasing Southeastern Area Chromium Concentrations and Associated Remedial Actions (2018 Southeastern Area Workplan; Arcadis 2018c). In the Fourth Quarter of 2018, two extraction wells (EX-66 and EX-67, shown in orange on the left panel of Figure 2-5) were also constructed, as described in the Southeastern Area Workplan, to improve hydraulic control. Wells EX-66 and EX-67 became operation in April 2019. This project was additional to the remedial infrastructure evaluated in the RTA (Arcadis 2014) and the 2017 Annual Report (Arcadis 2018b).
- Freshwater Injection Pilot Test Using Former PG&E Supply Well PGE-6:** Beginning in October 2019, a freshwater injection pilot test began with injection into former supply well PGE-6 to assess if long-term freshwater injection may be a viable additional remedial alternative for future enhancement of hydraulic containment and clean water flushing along the southeastern plume boundary. The freshwater pilot test was conducted in accordance with a workplan submitted on May 13, 2019 (Arcadis 2019b). Construction to connect the existing freshwater conveyance line from freshwater

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supply wells FW-03 and FW-04 to pilot test injection well PGE-06 (shown as a blue square to the southeast on the right-hand panel of Figure 2-5) was completed before the pilot test.

- As shown on Figure 2-3, significant progress has been made towards remedy implementation since the 2015 CAO was issued. A comprehensive evaluation of the effectiveness of remedy components that have been implemented towards reaching remedial targets and recommendations for improvements for remedy performance is provided in Section 3, while evaluations for each remedial system is provided in Sections 5 and 6. Figure 2-6 shows the planned 2020 remedy enhancements including investigation, design, and construction.

2.4 Operational Plans for April 2020 through March 2021

Monthly operational plans for 2016 through 2019 are provided in the Annual Cleanup Status and Effectiveness Report (Arcadis 2016a, 2017a, 2018b, and 2019a) for that year in accordance with the CAO. Actual operations and system effectiveness in accordance with these operational plans are discussed throughout Sections 5, 6, and 8 and are compared to planned operations summarized in Table 2-3.

3 FOUR-YEAR PERFORMANCE ASSESSMENT

Over the last four years (2016 through 2019), significant remedial progress has been made at the site in several key areas: solidifying remedy selection and design methodology, understanding plume conditions, removing mass from groundwater, and reducing the aerial extent of the plume. Advancements in each of these areas are necessary and work in concert to progress the project toward reaching the target concentrations in CAO Requirement VI (Water Board 2015). This section first provides a comprehensive performance evaluation of the data collected to date and an assessment of whether the remedy is achieving expected concentration reductions and is on track to reach target concentrations. The comprehensive data evaluation is followed by a section evaluating whether the remedy is on track with modeling predictions. The modeling evaluation included updating the modeling predictions with data collected over the last four years and using the update modeling predictions to evaluate progress toward reaching deadlines. This section concludes with a summary of plans to enhance effectiveness of the remedy to improve progress toward the CAO remedial timeframes, with focus on the areas exhibiting chromium concentrations greater than 50 micrograms per liter ($\mu\text{g/L}$), which is the 2025 cleanup target.

3.1 Comprehensive Evaluation of Progress

Validation of Design Methodology

Figures 3-1, 3-2, and 3-3 present the evolution of the Cr(VI) plume over time showing the entire southern plume area (Figure 3-1) and the IRZ area (Figures 3-2 and 3-3). Figures 3-2 and 3-3 shows the plume outlines in the shallow and deep zones of the Upper Aquifer, respectively, before the implementation of the IRZs (showing inferred baseline conditions in early 2008) and in 2017 and 2019. As discussed in more detail in Section 5 and 6, the remedy is generally working as designed. North of Barstow-Bakersfield Highway, the extraction system and ATUs are working to contain and shrink the 10 and 50 $\mu\text{g/L}$ plumes inward and southward (Figure 3-1). South of Highway 58, the IRZ systems, where operated, are shrinking the 10 and 50 $\mu\text{g/L}$ plumes from the inside out (Figures 3-2 and 3-3). Performance data are continuously reviewed as part of a feedback loop to inform daily system operations, to validate remedy applicability, and to improve the remedy design. Improvements in remedy design implemented under the CAO in the first four years included:

- A decrease in IRZ well spacing and an increase in the number of injection wells in the SCRIA and Source Area IRZs, with 12 wells installed beyond what was planned in 2015 (See Section 6.2.1 and 6.3.1); and
- Optimization of extraction system operations and installation of two key new extraction wells to draw the plume southward in advance of the timing planned in 2015 (See Section 5.1.1).

Updated Evaluation of Best Available Technologies

The 2015 CAO requires that this four-year assessment provide research of BATs that may be available to remediate chromium in groundwater sooner than the target deadlines in the 2015 CAO. The FS for the site recommended that the remedy be comprised of in situ remediation for the plume core, hydraulic containment via groundwater extraction, and treatment by agricultural fields and freshwater injection (Haley and Aldrich 2010). This recommended remedy is being implemented to meet the requirements of the 2015 CAO. The primary benefits of this approach, recognized in the FS, included the speed of re-

establishment of groundwater conditions to meet maximum contaminant levels (MCLs) and re-establish beneficial use through in situ treatment of the plume core, robust containment of the plume through groundwater extraction and freshwater injection, productive use of extracted groundwater through production of agricultural feed crops, and reduction of nitrate impacts from non-PG&E sources through agricultural treatment (Haley and Aldrich 2010).

At the time of the FS, aboveground treatment technologies under review included those identified as California BATs for Cr(T) treatment including Reduction, Coagulation, and Filtration (RCF) with ferrous iron, ion exchange, and reverse osmosis as well as technologies other than California BATs, including agricultural treatment and membrane bioreactors (Haley and Aldrich 2011c). Since the time of the FS, PG&E has further evaluated biological treatment with a two-stage submerged fixed-bed film bioreactor and reduction (Geosyntec 2017), and reduction/filtration by stannous tin (RF-Sn[II]) was evaluated in the industry as a potential BAT when the California Cr(VI) MCL was under development (Blute et al. 2013). Details on the evaluations of these two technologies are presented in Appendix E. While the fixed-film bioreactor and RF-Sn(II) technologies are both effective alternatives for aboveground treatment of Cr(VI), the availability of these options does not change the balance of criteria used in recommending the remedy in the FS.

As detailed throughout this report, the pace of remediation in response to in situ injections and groundwater extraction is a function of the hydrogeology of the subsurface. This pace of cleanup would not be enhanced through the application of an alternative ex situ treatment technology. Ongoing operations of the ATUs for beneficial use of extracted water and chromium treatment continues to reduce legacy nitrate impacts to groundwater, validating the remedy selection of the ATUs. Based on this evaluation, the combination of the current technologies of in situ treatment, groundwater extraction, and freshwater injection continues to comprise an expeditious, beneficial and productive approach to achieving the 2015 CAO goals.

Progress in Understanding Plume Conditions

Before remedy implementation under the 2015 CAO, heterogeneity in the Cr(VI) distribution was unknown based on the then existing monitoring well network. The understanding of the heterogeneity in the Cr(VI) distribution was expected to improve as wells were constructed in new areas. It was also recognized at the time that areas of high Cr(VI) concentrations could reside within tight lithologies that may be difficult to treat or show rebound after initial treatment. In the last four years, significant progress has been made toward improving the understanding of plume conditions through proactive investigations of areas of persistent or rebounding Cr(VI), as shown on Figure 3-4:

- Under the compressor station where residual source mass was found to be the source of rebounding concentrations at MW-01 (See Section 6.3.1);
- In the Western IRZ where elevated Cr(VI) in a key area for the next phase of remediation was revealed (see Sections 6.1.1 and 6.2.1); and
- In the Deep Eastern SCRIA where elevated concentrations were found to be present upgradient of a difficult-to-treat area (See Section 6.3.1).

The identification of these areas was a key first step toward designing and implementing remedy enhancements to progress treatment of these high concentration areas to meet the 10 and 50 µg/L targets. The plans to address each of these areas are presented in further detail in Section 6.

In addition to the changes in the understanding of plume conditions discussed above over the 2016 through 2019 period, new information on the Lockhart Fault system (Figure 2-1) has recently been published by the United States Geological Survey (USGS, Miller et. al, 2018). The USGS efforts to develop a greater understanding of the Lockhart Fault system were conducted as one part of several elements in the Hinkley chromium background study (Izbiki and Groover 2018). A final chromium background study report is pending; however, the improved understanding of the Lockhart Fault system revealed in Miller et. al, 2018, has shown that there are numerous fault splays present throughout the southern plume area. The additional Lockhart Fault system splays are present in areas that include the SCRIA and SA IRZ systems rather than a single fault trace southwest of the Compressor Station as illustrated on Figure 2-1. The hydrogeologic influences of these newly identified fault splays within the plume core areas, containing the highest chromium concentrations on site, are just beginning to be understood. The fault splays represent a significant additional subsurface complexity that will need to be evaluated and incorporated into future remedial design, operations, and groundwater flow modeling.

Progress in Reducing Concentrations, Removing Mass from Groundwater, and Reducing the Aerial Extent of the Plume

Performance data collected over the last four years demonstrate significant progress toward reducing concentrations, removing mass, and reducing the aerial extent of the plume (Figures 3-1 through 3-3). Mass removal is a common and useful metric for tracking remedial progress over time, taking into account reductions in both aerial extent and concentrations of Cr(VI). As required by the CAO, each year, mass removal during the previous year and cumulatively over time are estimated to track the progress of the remediation. It should be noted that the mass calculations are estimates and require assumptions to complete. Details on the assumptions (including Cr[VI] data used and assumptions related to saturated thickness under drought conditions) and procedures used to estimate mass removal estimates are provided in Appendix B. While there is uncertainty in the exact values of the estimates based on the need for assumptions, a relative comparison of the numbers is informative for an evaluation of treatment progress. The mass removal estimates show that approximately three times more mass (74 percent) has been removed from groundwater by remediation since 1992 compared to what remains (26 percent) in groundwater (Figure 3-5). As shown on the figure, the overall progress in removing Cr(VI), has included contributions from historical operations of the Ranch and East LTUs from 1992 through 2001, as well as the operation of ATUs/LTU since 2004 (the current DVD ATU was formerly operated as an LTU from 2004 through first quarter 2014) and IRZs since late 2007. Since the CAO was established, mass removal progress has been steady, as shown on Figure 3-6, with contributions from both IRZs and ATU remedial systems.

In addition to removing mass, the areal extent of the 10 and 50 µg/L plumes are decreasing, demonstrating progress toward 2015 CAO requirements. Figure 3-1 shows how the 10 and the 50 µg/L plume areas are shrinking, with a retreat of the 50 µg/L contour of approximately 2,000 feet from the north and a retreat of the 10 µg/L contour by approximately 2,500 feet from the north and approximately 1,500 feet from the west (see Section 5.1.1). Figure 3-7 provides another method for assessment of the contraction of the 10 µg/L plume area in the north using the methodology described in Section IV of the 2015 CAO MRP. Section IV of the 2015 CAO MRP provides a network of monitoring wells to measure the change in area in the plume consistently over time (Figure 3-4). The bar chart shown on Figure 3-7 shows a steep decline in the estimated area with chromium concentrations remaining greater than 10 µg/L in the north over the last four years using this methodology. Based on monitoring data through 2019, there has been an approximate 67 percent reduction in the aerial extent of the 10 µg/L plume area (33

percent remaining). The linear trend line on Figure 3-7 shows one way to track whether the area reduction is on track assuming that steady progress is made over time. The actual remaining area is trending toward the goal of 80 percent reduction (20 percent remaining) much more quickly than needed to reach the 2032 deadline (i.e., is proceeding much more quickly than the steady linear metric). The success in reducing the areas containing chromium concentrations greater than 10 µg/L reflects the ability to quickly effect change in the dilute northern portion of the plume through extraction and freshwater injection and is also due to the proactive steps toward optimization of the extraction system taken ahead of the schedule planned in the RTA during the last four years (See Section 5.1 for more details).

Cleanup is also progressing throughout the 50 µg/L plume area south of Barstow-Bakersfield Highway (Figures 3-2 and 3-3). Figure 3-8 shows the trend in area remaining for the 50 µg/L plume using the methodology described in the Section IV of the 2015 CAO MRP. The trend in area remaining calculated with this metric is showing progress toward reaching 50 µg/L across 90 percent of the plume (10 percent remaining). The trend shows that the remedy is on track, although there is some uncertainty in whether the 90 percent target will be fully met in 2025. Assuming steady progress over time (represented by the linear trend on Figure 3-8), the 2025 goal is projected to be met. Assuming that as treatment progresses the remaining areas become progressively slower to treat (represented by the logarithmic trend on Figure 3-8), it could take several years beyond 2025 to reach 50 µg/L across 90 percent of the plume. Note, the 10 µg/L metric is on pace whether evaluating on a logarithmic or linear trend, and the less conservative linear trend line was presented for simplicity on Figure 3-7. These projections are consistent with the updated modeling presented in the next section and with the observations of slower treatment observed in higher concentration areas.

Progress is fast and more complete toward the 10 and 50 µg/L goals in the northern portion of the plume area from Frontier Road to Barstow-Bakersfield Highway, where initial concentrations were in the 50 to 100 µg/L range. Progress toward reaching the 10 and 50 µg/L goals is steady but slower in the southern portion of the plume, where Cr(VI) concentrations were initially greater than 500 µg/L (Figure 3-2 and 3-3). For example, areas of treatment to less than 10 and 50 µg/L extended over 800 to 3,000 feet downgradient of the Central Area (shown in detailed Central Area Figures 6-1 and 6-2 in Section 6), where initial concentrations ranged from 50 to just more than 100 µg/L.

In contrast, in higher concentration areas further south and closer to the original source, achievement of the 10 and 50 µg/L goals is proceeding steadily but relatively slowly. For example, in the Source Area, Cr(VI) concentrations decrease to less than 50 µg/L within proximity to injection well transects (shown in detailed Source Area Figures 6-5 and 6-6 in Section 6). Further downgradient of the Source Area injection wells, Cr(VI) concentrations are significantly declining by an order of magnitude from 1,000s µg/L to 100s of µg/L, but have yet to reach the 2015 CAO target concentration of 50 µg/L in some places (Figures 6-5 and 6-6, discussed in more detail in Section 6.3.1). In particular, two areas with initial Cr(VI) concentrations greater than 1,000 µg/L, the deep east SCRIA and plume near SA-MW-05D (labeled on Figure 3-4), have been particularly slow to treat to 50 µg/L, although progress has improved through investment in additional investigation and remediation wells in these two areas.

3.2 Modeling Predictions

In 2014, an RTA was completed to develop a range of remedial timeframes for groundwater cleanup and to characterize the certainty of timeframe estimates (Arcadis 2014). The modeling effort produced a range

of outcomes from various model layers representing variability in hydrogeologic conditions encountered at the site as well as two different modeling input scenarios. The modeling input scenarios had variable assumptions in the amount of organic carbon distribution that was sufficient for Cr(VI) reduction. The RTA estimates for cleanup ranged from 6 to 23 years (i.e., complete in 2021 to 2038) to remediate 99 percent of the 50 µg/L southern plume and seven to 50 years to remediate 99 percent of the 10 µg/L southern plume (i.e., complete in 2026 to 2065). Finding 22 of the 2015 CAO captured this range of estimates and stated that estimated timeframes from the RTA informed the cleanup timelines incorporated into the 2015 CAO. The exact deadlines in the 2015 CAO are sooner than the range of estimates provided in the RTA with the cleanup timeframe for 90 percent of the 50 µg/L area set for 2025 (10 years) and the cleanup timeframe for 80 percent of the 10 µg/L area set for 2032 (17 years).

The RTA and Finding 22 of the 2015 CAO also recognized that the timeframe estimates were uncertain given “underlying, simplified assumptions in the modeling, uncertainty in conditions throughout the modeled aquifer, operational and construction uncertainties and assumptions made on the timing and continuation of permitting for the project” (Water Board 2015). The RTA noted that the modeling estimates were intended to provide a guide for evaluation of remedy performance over time, did not provide definitive predictions for remedy timeframe, and should not be used with the expectation of certainty. In accordance with the 2015 CAO requirements for this four-year effectiveness assessment, data from the last four years were used to update the groundwater modeling and evaluate the progress to reach target concentrations by the deadline with updated predictive modeling. A summary of the four-year modeling evaluation is provided in this section, and a complete report is provided in Appendix D.

A comparison of Fourth Quarter 2019 actual plume conditions to model results revealed that the RTA modeling predicted greater areas of treatment by Fourth Quarter 2019, four years into the 2015 CAO, than was observed (Figure D-1, D-2 and D-3). The comparison indicated four main reasons for the difference in model predictions versus actual results:

- Areas of the plume that were characterized since 2015 through proactive investigations resulting in additional areas or mass to treat in the western plume, Deep East SCRIA, shallow zone near MW-208, and under the compressor station (Figure 3-4);
- Differences between actual operations and simplified model operational assumptions;
- Overprediction of the area of organic carbon distribution and stimulation of IRZs in the model; and
- Slower actual treatment than predicted in several higher concentration areas, as discussed in Section 6.

The heterogeneity in Cr(VI) distribution and pace of remediation were not predicted in the RTA modeling, but it was foreseen that such heterogeneities could occur, as stated in the report, “the influences of aquifer heterogeneities on plume behavior, mass removal, reagent delivery and IRZ performance cannot be described or predicted prior to remedy implementation, and cannot be fully predicted with the solute transport model. In addition, the model cannot fully describe the heterogeneity in the Cr(VI) distribution and areas where there may be more mass loaded into tighter lithologies or the immobile pore space or areas which may not be in communication with the rest of the aquifer. Such areas may be more difficult to treat or may show rebound after treatment and require additional remediation” (Arcadis 2014).

To update modeling predictions for reaching remedial timeframes in the 2015 CAO, two modeling scenarios were used to bracket the range of expected timeframes. For the optimistic end of the range,

the input scenario from the RTA modeling that required more organic carbon for Cr(VI) reduction was used with a modification to allow Cr(VI) reduction after organic carbon dissipates. For the more conservative end of the range, data collected over the last four years were used to modify modeling parameters. Updates to the input parameters in this scenario included further increasing organic carbon required for Cr(VI) reduction, increasing the duration of Cr(VI) reduction persists following consumption of organic carbon, and adjusting the rate at which Cr(VI) mass transfers between the mobile and immobile pore space within the aquifer. The operating assumptions in the model input were based on actual well rotations, flow rates, target depth intervals, and total organic carbon (TOC) concentrations implemented over the last four years. Remedial infrastructure assumed in the modeling consisted of wells that have already been built as well as the current expansion plans previously proposed including (Figure 2-6):

- Injection into converted extraction wells north of WBC, shown in yellow on Figure 2-6 (Arcadis 2019d);
- Construction of an expanded Western IRZ per the Basis of Design (BOD) submitted on June 6, 2019 shown in green and orange on Figure 2-6, assuming the Water Board issues a revised IRZ NOA in 2020 and construction and operation by 2021;
- Construction of a set of injection wells in the northeastern corner of the SCRIA per the original design (Arcadis 2014) and operation by 2021, area shown in a box on Figure 2-6; and
- A remedy on the compressor station per the design notification submitted on October 11, 2019 (Arcadis 2019e) with Phase 1 extraction implemented in early 2020 (shown on Figure 2-6) and Phase 2 injection implemented in 2022.

The 2015 CAO goal for the 50 µg/L plume is to reach 50 µg/L across 90 percent of the plume by 2025. The updated modeling results show a range of predictions for 2025, with the optimistic scenario predicting achievement of 50 µg/L across 90 to 97 percent of the plume area and the conservative scenario predicting achievement of 50 µg/L across 68 to 87 percent of the plume area². The results of this modeling indicate that the performance could be shy of the 90 percent area in 2025 target due to the occurrence of slower-to-treat mass in the deep east SCRIA; persistent mass in the northern source area under the surface impoundments; delays in obtaining permits from USFWS, CDFW, and the Water Board; and places where existing and planned infrastructure are insufficient (see Appendix D for details).

Overall, these results indicate that considerable progress toward the 50 µg/L plume goal will be made by 2025. However, updated modeling results indicate uncertainty in meeting the 2025 deadline, which could result in requiring additional time beyond 2025 (Table D-6). While the optimistic scenario predicts achievement of the 50 µg/L goal by 2025, the conservative scenario predicts achieving the goal between 2031 and under the worst-case scenario by 2035. Actual results are expected to fall in between these scenarios. Together, these results show that the remedy is on the right track for meeting the 50 µg/L goal but may need enhancement and might extend beyond 2025.

The updated model scenarios predict that the 2015 CAO target for treatment of 80 percent of the 10 µg/L plume in 2032 will be reached between 2030 and 2058 (Table D-7). Although the model updates are slower than projected in the RTA modeling assessment, the updated range is consistent with the

² Percent complete assumes that the 12 percent of the plume area in the shallow zone that is currently dewatered due to drought remains dewatered.

uncertainty presented in the RTA modeling and within expectations of how an actual aquifer system would behave in comparison to a model.

Both the modeling and the actual results demonstrate the progress of remediation toward the 10 and 50 µg/L CAO goals to date but highlight the uncertainty, particularly for reaching the 50 µg/L goal by 2025. The next section looks at remedy enhancements to address this uncertainty, with a focus on the 50 µg/L goals.

3.3 Conclusions and Recommendations to Improve Effectiveness

Over the last four years, an adaptive management approach has been implemented, and more than double the amount remedial infrastructure planned was proactively constructed and operated to keep the remedy progressing and performing toward the 2015 CAO remedial goals (i.e., 73 remedial wells have been installed since 2015 in comparison to the 35 that were planned in the RTA). Together, the actual performance and modeling prediction updates demonstrate considerable progress toward 2015 CAO deadlines, but there is uncertainty associated with areas of elevated concentrations that were not known in 2015, areas that may be influenced by the complexity of the newly identified fault splays, areas of slow performance that may take time beyond the 2025 deadline to treat to 50 µg/L, and areas where remediation is on hold for permitting revisions. The hydrogeologic influences of newly identified fault splays are just beginning to be understood. Therefore, they were not included in the updated flow modeling presented herein. As the hydrogeologic influences of the fault splays are better understood, they will be incorporated into the site flow model for future remedial system assessment to the extent possible.

Accordingly, as contemplated by the 2015 CAO, a workplan will be submitted by April 29, 2020 proposing recommendations and an implementation schedule to build on the infrastructure that has already been added to the RTA design to improve effectiveness. Based on modeling results indicating areas of remaining mass in 2025, as discussed above in Section 3.2 and shown on Figures D-5 and D-6 in Appendix D, the workplan will include improvements in the following areas:

- Western IRZ (Section 6.1.2 and 6.2.2): the next phase of construction will be recommended as soon as the Water Board modifies the IRZ NOA to allow for injections in this area. Additional infrastructure is proposed in the Western IRZ expansion to accommodate treatment of the elevated Cr(VI) identified in this area in SCRIA performance evaluations and in the modeling (shown in turquoise box on Figure 2-6).
- Northern Source Area Investigation (Section 6.3.2): to evaluate the nature of the residual mass in the shallow zone in the northern Source Area under the existing surface impoundments such that remedy enhancement options can be evaluated and proposed, shown on Figure 2-6.
- Eastern Central Area IRZ enhancements (Section 6.1.2): to complement and make up for the delayed construction of the northeastern SCRIA expansion (Figure 2-6) associated with USFWS and CDFW permitting timelines.

These changes, in conjunction with the extra remedy infrastructure installed to date, are expected to significantly advance and maintain the current steady progress toward the 2025 90 percent treatment target for the 50 µg/L plume.

4 DROUGHT AND EFFECT ON HINKLEY GROUNDWATER LEVELS

California has experienced drought conditions of historical significance in recent years. The drought that included the water years of 2012 through 2016 included the driest four-year period of California statewide precipitation on record (2012 to 2015) and the smallest Sierra-Cascades snowpack on record, with 2015 only recording 5 percent of average (NIDIS 2020). The years of 2014, 2015, and 2016 were also recorded as California's first, second, and third warmest years in terms of statewide average temperatures. These severe drought conditions resulted in California Governor Jerry Brown declaring a drought emergency that mandated water conservation requirements for the first time in California history (Washington Post 2017). The winter of 2016/2017 brought rain and snow to much of California, and the State of California drought emergency was ended on April 7, 2017. However, prevalent drought conditions remained present in the Mojave Desert in 2017, where groundwater is the primary source of water for domestic, municipal, and agricultural use. These drought conditions continued in 2018 and 2019.

The Hinkley Valley aquifer is almost entirely replenished by intermittent Mojave River flows, which require very large storm events for the river to flow sufficiently and result in groundwater recharge (Brookman-Edmonston and Science Applications International Company 2005). Recharge to the Hinkley Valley aquifer from the intermittent Mojave River flows is supplemented with imported water sourced from northern California that is applied to the Lenwood Recharge Basin (see Figures 4-1 and 4-2). The recharge basin program developed by the Mojave Water Agency at Lenwood periodically imports water from the State Water Project that is applied at the riverbed to percolate into the aquifer and replenish the aquifer in addition to the intermittent Mojave River flows (Mojave Water Agency undated).

Due to the lack of Mojave River flows and limited Lenwood Recharge Basin imports in recent years, groundwater levels in the Hinkley Valley and greater area have generally shown a steady decline since 2011 when the last significant Mojave River flows occurred (Figure 4-3). Figure 4-3 shows groundwater levels near the Mojave River (blue and black lines), and near the eastern outline of PG&E's chromium plume at Summerset Road and Community Boulevard (yellow-black line), with Mojave River flows and Lenwood Recharge Basin flows shown on the chart below the groundwater levels. As shown on Figure 4-3, the last time the Mojave River flowed significantly (blue bars on bottom chart) was in 2011, and before that, in 2005. A single short-duration, low-volume flow event occurred on February 16, 2019; however, little to no aquifer recharge was observed. As indicated by the blue and black lines showing groundwater levels rising near the Mojave River, the 2005 river flow events were more substantial than those recorded in 2011. The 2005 flows were then also subsequently supplemented with significant applications to the Lenwood Recharge Basin in the years following the 2005 river flows. However, imports to the Lenwood Recharge Basin (green bars on bottom chart) were limited after the 2011 Mojave River flow event and have generally been limited since 2008, allowing for further groundwater level decline. Lenwood Recharge Basin applications were resumed in 2019 (data not available to plot on Figure 4-3); however, as indicated by the groundwater levels for monitoring locations near the river, the 2019 Lenwood Recharge Basin applications were not enough to reverse the downward groundwater level trend. Groundwater levels have not been measured as low as they were in 2019 since 1992 (Figure 3-1).

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In 2019, groundwater levels near the eastern side of the chromium plume outline were up to 20 feet lower than the levels recorded in 2000 and 2008. Declining groundwater levels of this magnitude were not anticipated in the RTA and have the potential to impact cleanup progress. This is particularly a concern in the western portion of the Source Area and southwestern SCRIA areas, where the previously thin shallow zone of the Upper Aquifer is slowly becoming dewatered by declining groundwater levels, thereby potentially limiting the effectiveness of IRZ systems in these areas. This is discussed in greater detail in Section 6.4. Additional remedial infrastructure was installed in 2018 and 2019 to enhance the remedial progress and counter the effects of the drought in the southeastern area of the site, where flattening hydraulic gradients were raising concerns about the potential for plume expansion.

Since 2015, more than 50 monitoring well screens have gone dry, or groundwater levels within the well screens are so low that groundwater sample collection has become difficult. Many more monitoring wells are likely to become dry in the future with continued drought conditions. The declining groundwater levels have also made remedial actions more challenging. Remedial challenges associated with lower groundwater levels include:

- Less water available for groundwater extraction to support ATU and IRZ remedial systems;
- Changing hydraulic gradients that may affect remedial system effectiveness within the plume core; and
- A reduction in planned IRZ injection rates along the plume margins due to a greater risk of plume bulging from IRZ injection.

As discussed in Section 4.1.2, in 2018, PG&E began adapting to these changing conditions and installed eight piezometers (Figures 4-1 and 4-2) east and southeast of the plume area to better understand flow conditions. In 2018/2019, PG&E also commenced remedial actions to proactively address the flattening gradients, improve hydraulic containment, and improve flushing by constructing ten extraction wells along the east and southeastern margins of the chromium plume.

5 HYDRAULIC CONTROL

This section provides an evaluation of the effectiveness of hydraulic control north and south of Barstow-Bakersfield Highway for the reporting period, documents extraction system enhancements, provides recommendations for continuing to improve remedial effectiveness, and presents the 2020 operational plans to continue maintaining hydraulic capture of chromium-affected groundwater at the site.

5.1 Hydraulic Control

Groundwater extracted for agricultural operations associated with the northern ATUs (NATUs) and southern ATUs (SATUs) provides hydraulic containment of chromium-affected groundwater and supplies groundwater for agricultural treatment and in situ treatment of Cr(VI). Figure 2-1 shows the locations of the ATUs and extraction wells. Table 2-1 provides a general chronological history of the agricultural operations and the remedial systems.

Hydraulic containment on the western portion of the chromium plume is enhanced by localized freshwater injection in up to six injection wells at the Northwest Freshwater Injection (NWFI) system (CH2M HILL, Inc. [CH2M] 2013). Figure 2-1 shows the location of the NWFI system.

5.1.1 Upper Aquifer Southern Plume, North of Barstow-Bakersfield Highway

This subsection discusses the remedial implementation, extraction system enhancements, and effectiveness of remedy operations for hydraulic control in the southern plume north of Barstow-Bakersfield Highway and to just north of Thompson Road. For this area, the remedy includes operation of the extraction well network north of Barstow-Bakersfield Highway, with treatment of extracted groundwater at five NATUs (Figure 2-1) and injection of freshwater (sourced outside of the chromium plume) into the NWFI system (Arcadis 2014).

5.1.1.1 Remedial Implementation and Effectiveness

Maintaining hydraulic control while optimizing the extraction system for plume contraction and mass removal is a primary focus. Hydraulic control has been demonstrated throughout optimization activities discussed below using the hydraulic containment target areas (gold line on Figure 5-1 and black line on Figure 5-2) and calculating inward groundwater gradients at well pairs and well triplets. The optimization and operational data from maintaining hydraulic control have continued validating the design and implementation approach for hydraulic containment in the north. Hydraulic control is documented quarterly in accordance with the 2015 CAO. Revised recommendations for the hydraulic containment targets (Figures 5-1 and 5-2) were submitted to the Water Board on August 31, 2016 (Arcadis 2016d). The revised hydraulic containment target areas and well pairs and triplets are outlined in the 2015 CAO issued by the Water Board on November 22, 2016 (revised CAO; Water Board 2016b).

For the containment system north of Barstow-Bakersfield Highway, hydraulic containment was maintained throughout the reporting period during significant progress toward reducing chromium concentrations and reducing the aerial extent of the plume. As shown on Figure 3-1 the 10 µg/L plume is quickly retreating southward in the Upper Aquifer, with optimization occurring many years ahead of plan. The RTA assumed that the first major change to the extraction locations and rates would occur after 10 years;

however, optimization began with reconfiguration of the extraction well network following a pilot test in the winter of 2014-2015.

Starting in the winter months of 2014 and 2015, pilot testing was conducted to assess alternatives to optimize the groundwater extraction well network followed by additional pilot testing during the winter months of 2015 and 2016. These two winter seasons of pilot testing provided a feedback loop for optimization: pumping reconfigurations were tested, and data collected during the testing validated the performance of the planned optimizations. The 2014 and 2015 pilot test validated that hydraulic control at the north end of the shallow zone of the Upper Aquifer could be maintained without extraction in the deep zone of the Upper Aquifer in this area (Figure 5-1) and that the effectiveness of the system could be improved by shifting extraction south (Arcadis 2015).

As depicted on Figure 5-1, the estimated hydraulic capture zone in the shallow zone of the Upper Aquifer remained unchanged after northern extraction wells were converted to shallow zone only extraction, and deep zone extraction rates north of Santa Fe Avenue were reduced. Extraction rates south of Santa Fe Avenue were increased to target mass removal and limit the mass flux of chromium to the north. The extraction system was reconfigured in 2015 following the pilot test and further fine-tuned based on the results of another pilot test conducted in the winter of 2015 and 2016 (Arcadis 2016b). The reconfigured groundwater extraction system improved mass removal effectiveness. The volume of water extracted to achieve the same Cr(VI) mass removal from groundwater was reduced by 21 percent in the first half of 2015 compared to the first half of 2014. This increased efficiency, while maintaining hydraulic containment, allowed for fallowing of the DVD Northwest Field and Gorman North ATU in 2017.

To further optimize, enhance mass removal, and improve overall hydraulic control, extraction wells EX-53 and EX-62 were installed as part of the adaptive management. These wells were not evaluated in the RTA and have accelerated chromium concentration reductions. EX-53 was installed in 2017 within the northern chromium plume core to reduce northward chromium mass flux and to support lateral plume contraction. Extraction rates (up to 200 gallons per minute [gpm]) at well EX-53 are among the greatest of all of the northern extraction wells. Operation of this well has functioned as envisioned in limiting northward mass flux and has enhanced inward gradients to draw groundwater with lower chromium concentrations inward, resulting in plume contraction. Focused extraction from extraction wells EX-53 and IW-01 within the plume core made operation of EX-15, EX-16, and EX-20 unnecessary for achieving hydraulic and plume containment in this area. The original Action Plan for the Western Area (Western Action Plan; Arcadis 2013) required operation of the NWFI system, three of the Northwest Area extraction wells (EX-15, EX-16, and EX-20), and the Western Area extraction (WAE) system (EX-36). On September 26, 2017, PG&E submitted a proposal to modify the Western Action Plan (Arcadis 2017c). Water Board staff issued a request for public comments on the proposed modifications from February 20 to March 21, 2018 (Water Board 2018a). No public comments were received, and the Water Board accepted PG&E's request on July 25, 2018 (Water Board 2018b). Although full-scale operation of the NWFI system is likely no longer needed for plume containment, the NWFI system will continue to be operated.

EX-62 was installed in Second Quarter of 2018 as a proactive measure to enhance the northern capture system and to address an increasing chromium trend at monitoring well MW-80S. The increase of chromium at MW-80S was interpreted to represent a remnant of mass localized to an area near this well rather than a loss of hydraulic control. Before startup, Cr(VI) concentrations at MW-80S declined to below

3.1 µg/L, and were below 3.1 µg/L during 2019. This adaptive management action increased the estimated zone of hydraulic capture in the shallow zone of the Upper Aquifer (Figure 5-1).

Shifting extraction south resulted in the retreat of the 50 µg/L plume (Figure 5-2) and reduced the aerial extent of the 10 µg/L plume in both the shallow and deep zones (Figures 5-1 and 5-2) by reducing northward mass flux. The 50 µg/L plume has retreated more than approximately 2,000 feet to the south. On the western side of the plume, chromium concentrations have rapidly decreased east of the NFWI system since injection operations began in 2010, and extraction rates increased in 2011 (Figure 5-1). In the shallow, the 10 µg/L plume decreased approximately 2,500 feet from the north and approximately 1,000 feet from the west (Figure 5-1). In the deep zone, the 10 µg/L plume decreased approximate 1,750 feet from the north and approximate 740 feet from the west (Figure 5-2).

NATU operations compared to the 2019 operational plan are summarized monthly in Table 2-3. Operational flow rates for the NATUs exceeded plan goals in 2019 except during the wet months of March and April, when operations were below planned rates to prevent ponding and crop damage by overwatering. Overall performance of the NATUs was not impacted by the reduced rates of March and April monthly averages, as the annual NATU flow rate of 820 gpm remained above the planned rate of 768 gpm. Fallowing of the DVD northwest field and the Gorman North ATU (Figure 2-1) continued as planned during 2019 and is expected to continue in the future to provide the benefits of avoiding groundwater extraction from wells containing low chromium concentrations and overall optimization of the groundwater extraction system. Actual flow rates for the NATUs were presented in Table 2-2 of the Fourth Quarter of 2019 ATU Monitoring Report (Arcadis 2020c), and a copy of that table is provided in Appendix A. During 2019, water extracted by the southernmost NATU extraction wells (EX-53, EX-15, EX-16, and EX-20) was diverted as needed to supply the SCRIA/Central Area IRZs. Diversion flow rates to the IRZ systems are presented in Table 2-2 of the Fourth Quarter of 2019 ATU Monitoring Report (Arcadis 2020c), and a copy of that table is provided in Appendix A.

Operational flow rates for the NFWI system met or exceeded plan goals in 2019. Actual flow rates for the NFWI system were presented in Table 3-13 of the Fourth Quarter of 2019 IRZ Monitoring Report (Arcadis 2020a), and a copy of that table is provided in Appendix A.

5.1.1.2 Recommendations and Annual Operational Plan

Continued operation of the current remedial systems is recommended to maintain hydraulic capture under the revised hydraulic containment metrics. To reduce the potential for drawing chromium northward toward extraction wells containing lower chromium concentrations, reduce aquifer drawdown, and improve chromium removal efficiency by targeting extraction of groundwater with higher Cr(VI) concentrations, PG&E recommends continuing with the optimized flow rate scheme through 2020. Continued operation of the current remedial systems, with fallowing of select ATU fields as needed, is recommended to maintain hydraulic capture under the revised hydraulic containment metrics while continuing to achieve Cr(VI) mass removal and plume contraction.

The 2020 operational plan (April 2020 through March 2021) for the NATUs is provided in Table 2-4 and includes the planned annual monthly average flow rates. The 2020 monthly flow rates of extracted water applied to the NATUs are similar to the 2019 rates and are based on extraction rates needed to maintain year-round hydraulic containment and vary seasonally to support crops throughout the year.

The maximum application rates occur during the summer months, when temperatures and crop evapotranspiration rates are highest, and minimum rates occur during the winter months, when temperatures and crop evapotranspiration rates are low. Actual application rates may vary with implementation based on cropping and weather patterns. In accordance with the 2015 CAO (Water Board 2015), the Water Board will be notified if rates are reduced to more than 10 percent below the rates stated in the operational plan.

5.1.2 Upper Aquifer Southern Plume South of Barstow-Bakersfield Highway

This subsection discusses the remedial implementation, extraction system enhancements, and effectiveness of remedy operations to improve mass removal of Cr(VI)-affected groundwater and hydraulic control of Cr(VI) in groundwater within the Upper Aquifer south of the Barstow-Bakersfield Highway. For the southern plume south of Barstow-Bakersfield Highway, hydraulic control components of the remedy in the south include operation of the extraction well network south of Barstow-Bakersfield Highway and treatment of extracted groundwater at two SATUs (Figure 2-1), with some extracted water also used for IRZ injections.

5.1.2.1 Remedial Implementation and Effectiveness

In the Upper Aquifer south of the Barstow-Bakersfield Highway, the Southern ATUs (Community East and Fairview) were installed as part of the remedy in 2015. The first set of extraction wells (EX-38 through EX-52) was also installed as part of the remedy to target mass removal by applying water to the SATUs and to supply water to the IRZ systems. The extraction system was optimized by selectively extracting from wells with the greatest chromium concentrations to target mass removal and to limit drawing in groundwater containing iron and manganese associated with IRZ operations to prevent fouling of IRZ wells.

In 2018, remedial progress was enhanced through adaptive management focusing on improving hydraulic control. In response to increasing Cr(VI) concentration trends in both shallow and deep zone monitoring wells located along the eastern boundary of the chromium plume (Arcadis 2018a), a second set of new extraction wells (EX-55, EX-56, EX-59, EX-60, and EX-61) was installed, and one IRZ injection well (SC-IW-15) was converted to a deep zone extraction well on the eastern boundary of the plume near the Community ATU (north of Community Boulevard and west of Summerset Road; Figures 4-1 and 4-2). These extraction wells became operational in 2018 to address potential eastward plume movement due to changing hydraulic gradients resulting from drought conditions as discussed in Section 4 and to develop inward gradients to reduce concentrations at wells along the plume boundary with elevated but stable concentrations (Section 6.3). As depicted on Figures 4-1 and 4-2, potentiometric contours from the Fourth Quarter of 2019 show that capture zones (depicted as dark blue dashed lines) have formed along the eastern margin of the chromium plume in both the shallow and deep zones, respectively, of the Upper Aquifer.

To develop a greater understanding of groundwater flow east and southeast of the chromium plume under the current drought conditions, four multiple-depth piezometers (PZ-16 through PZ-19) were installed and developed in the Third and Fourth Quarters of 2018. The groundwater-level data for the new piezometers indicate that a groundwater divide remains east of the chromium plume boundary and that hydraulic containment continues to be maintained Figures 4-1 and 4-2.

A third set of extraction wells (EX-66 and EX-67) was constructed and became operational in 2019 (Figures 4-1 and 4-2) in response to increasing Cr(VI) concentrations at SA-MW-25S, BW-01S, and BW-01D (Arcadis 2018c) located south of Community Boulevard and in the southeastern Compressor Station area. Chromium concentration reductions at wells SA-MW-25S, BW-01S, and BW-01D were observed shortly after initiating groundwater extraction (Figures 5-3 and 5-4; Arcadis 2020b).

The new SATU extraction wells have allowed for improved hydraulic control and containment in areas where changes in hydraulic conditions were observed in 2017 and 2018 due to the drought. However, the drought continued through the winter of 2018/2019 with no significant Mojave River flows to provide water to the aquifer, and groundwater gradients east and southeast of the chromium plume continue to be flatter than historical gradients under these conditions. PG&E proposed a freshwater injection pilot test (PG&E 2019) to test if freshwater injection may be a remedial alternative to enhance containment and clean water flushing along the eastern plume boundary. The test was approved (Water Board 2019), and freshwater injection with water from wells FW-03 and FW-04 began October 21, 2019 into former PG&E supply well PGE-06. Based on initial hydraulic data collected, the injection may be generating favorable results; therefore, the test has been extended and is ongoing. Data obtained from the test will inform remedial strategies to maintain hydraulic control of the southeastern chromium plume area.

In 2019, operation of Community East ATU and the Fairview ATU continued as planned. Operational flow rates for the SATUs are presented in Table 2-2 of the Fourth Quarter of 2019 ATU Monitoring Report (Arcadis 2020c), and a copy of that table is provided in Appendix A. Table 2-3 of this report shows the planned versus actual discharge rates for the SATUs. Operational flow rates for the SATUs exceeded plan goals in 2019. During 2019, water extracted by the SATU extraction well network was used for irrigation of the SATUs and/or diverted to the IRZs. Diversion flow rates to the IRZ systems are presented in Table 2-2 of the Fourth Quarter of 2019 ATU Monitoring Report (Arcadis 2020c), and a copy of that table is provided in Appendix A.

5.1.2.2 Recommendations and Annual Operational Plan

Operation of the Community East and Fairview ATUs and the SATU extraction well network will continue in 2020. Adaptive management of the SATU extraction network will continue to enhance hydraulic control and maximize treatment. The following actions are recommended:

- Continue to operate the SATUs at agronomic rates.
- Continue extraction along the eastern portion of the plume to preserve inward hydraulic gradients.
- Continue extraction from existing wells containing the highest Cr(VI) concentrations to maximize mass removal, as feasible without drawing in excessive dissolved metals from IRZ operations.

The 2020 operational plan (April 2020 through March 2021) for the SATUs is provided in Table 2-4, which includes average monthly flow rate ranges of extracted water applied to the SATUs. The 2020 flow rate ranges are similar to the 2019 rates and vary seasonally to support crops. Ranges are provided for the SATUs to account for possible cropping changes and routine downtime associated with farming activities such as harvesting, replanting, and plowing. Because only two fields comprise the SATUs, if one field is down due to construction (like the 2019 construction under the Community East ATU) or routine farming activities (such as harvesting, replanting, or plowing), monthly average flow totals may be reduced significantly more than in the NATU area, where additional fields are available to distribute flow from extraction wells. The maximum application rates are during summer months, when temperatures and

evapotranspiration rates are highest, and minimum rates are during the winter months, when temperatures and evapotranspiration are low. Actual application rates may vary with implementation based on cropping and weather patterns. In accordance with the 2015 CAO (Water Board 2015), the Water Board will be notified if rates are reduced to more than 10 percent below the rates stated in the operational plan.

5.1.3 Lower Aquifer Southern Plume

5.1.3.1 Remedial Implementation and Effectiveness

Remedial actions taken to date are reducing chromium mass in the Lower Aquifer, and the remedy is progressing. As depicted on Figure 5-5, the Lower Aquifer Cr(VI) plume extent has reduced since 2015. Chromium trends from the Lower Aquifer wells validate that the remedial actions taken to date are appropriate, and the conceptual site model presented in the Updated Conceptual Site Model and Background Chromium Concentrations for Lower Aquifer Report (Lower Aquifer CSM Report; Arcadis 2016c). The Lower Aquifer is the saturated material below the blue clay, including weathered bedrock material. As depicted by the grey shaded area on Figure 5-6, there is a transitional area where blue clay has been described to be present in boring logs, but it is also intermittently present, thin, and sandy. In the presence of downward vertical gradients caused by Lower Aquifer extraction at former supply wells 26-65 and 26-66 (Figure 5-5), chromium is likely to have been drawn downward into the Lower Aquifer transitional clay area near the western limits of the Lower Aquifer, where the blue clay aquitard is thin, sandy, and/or absent.

The following remedial actions have been implemented to date:

- Upper Aquifer groundwater extraction for the ATUs, creating a large area of drawdown in the Upper Aquifer, enhancing upward vertical gradients from the Lower Aquifer toward the Upper Aquifer.
- Removal of the need for ongoing pumping of Lower Aquifer supply wells (26-65 and 26-66 also referred to as Ryken-8 and Ryken-9, respectively) by providing alternative water supply source from primarily supply wells FW-03 and FW-04, located upgradient of the chromium plume. Pumping from the Lower Aquifer supply wells 26-65 and 26-66 appears to have been a primary factor in creating the historical downward gradients between the Upper and Lower Aquifers.
- Ceasing extraction from Upper Aquifer extraction well EX-26 to limit the potential for extraction from that well to induce northerly migration of Cr(VI) into the Lower Aquifer.
- Operation of extraction well (EX-37) with screens across the Upper and Lower Aquifers.

Decreasing concentration trends are observed in monitoring wells estimated to be screened beneath the blue clay aquitard east of the grey shaded area (MW-23C and MW-42C; Figure 5-6). Chromium concentration decreases in wells MW-23C and MW-42C are attributed to the current remedial actions. These remedial actions limit northerly migration of Cr(VI) into the Lower Aquifer, minimize downward gradients between the Upper and the Lower Aquifers, and enhance upward vertical gradients from the Lower Aquifer toward the Upper Aquifer through groundwater Upper Aquifer extraction.

Concentrations have also decreased in monitoring wells MW-28C, MW-92C, and MW-100C as a result of remedial actions. Monitoring wells MW-28C, MW-92C, and MW-100C are located within the blue clay transition zone (grey area on Figure 5-6), where the blue clay is intermittently present, thin, and sandy,

resulting in hydraulic communication between the Upper and Lower Aquifers. As presented in the Lower Aquifer CSM Report (Arcadis 2016c), complete Cr(VI) concentration reductions in the transition zone at locations such as MW-92C and MW-100C were not expected to occur until Cr(VI) concentrations were first reduced in the Upper Aquifer given the hydraulic communication between the Upper aquifer and the transition zone.

Figure 5-5 shows chromium concentrations for the Lower Aquifer monitoring wells as well as the 10 µg/L plume in the deep zone of the Upper Aquifer for both the Fourth Quarter of 2015 (shown as a blue shaded area on the left panel) and the Fourth Quarter of 2019 (right panel). Between the Fourth Quarter of 2015 and Fourth Quarter of 2019, the 10 µg/L plume outline in the deep zone Upper Aquifer has contracted southeast of both MW-92C and MW-100C (Figure 5-5), indicating favorable conditions for concentration reductions as lower concentration groundwater in the Upper Aquifer slowly mixes with groundwater affected by chromium in the Lower Aquifer. However, after an initial favorable decrease in Cr(VI) concentrations in response to remedy implementation, recent Cr(VI) concentration trends at MW-92C have generally stagnated, and recent Cr(VI) concentration trends at MW-100C have increased (Figure 5-6). Chromium concentrations in MW-92C and MW-100C are higher (greater than 10 µg/L) than the Upper Aquifer concentrations above these wells, as shown as the blue shaded area on Figure 5-6. These observations suggest that additional changes to the flow conditions in the vicinity of MW-92C and MW-100C are likely needed to further improve Cr(VI) concentrations.

As a result, on January 9, 2020, PG&E submitted an email to the Water Board requesting approval to conduct an 18-month pilot test that will involve turning EX-29, EX-30, and EX-37 off to assess if gradients and concentration reductions may be improved by changing the extraction well configuration in this area. Turning off these extraction wells may facilitate flushing of surrounding groundwater with lower chromium concentrations through these wells. Additional information was provided to the Water Board on February 14, 2020 (PG&E 2020) following a request from the Water Board on February 6, 2020 (Water Board 2020). Approval to perform the pilot test is pending.

5.1.3.2 Recommendations and Annual Operational Plan

The current remedial actions for the Lower Aquifer are reducing the Cr(VI) plume footprint and mass in the Lower Aquifer. PG&E will continue implementing the following current remedial actions to reduce mass of Cr(VI) in the Lower Aquifer.

- Lower Aquifer supply wells Ryken-8 and Ryken-9 will remain off, except for very brief periods during which primary water supply from FW-03 and FW-04 is unavailable, to minimize the potential for inducing downward gradients between the Upper and Lower Aquifers.
- Upper Aquifer groundwater extraction will continue for the ATUs (i.e., EX-53, IW-01) to enhance upward vertical gradients from the Lower Aquifer toward the Upper Aquifer.
- EX-26 will remain off to prevent the potential for induced northern migration of Cr(VI) into the Lower Aquifer and to enhance vertical upward gradients near MW-100C.
- Operation of Upper Aquifer wells EX-29, EX-30, and Upper and Lower Aquifer screened extraction well EX-37 will continue except during evaluation of gradients with these wells off in the proposed pilot test.

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- To evaluate alternatives for future chromium concentration reductions at wells MW-92C and MW-100C, which are located within a complex hydrogeological setting, PG&E requested to conduct an 18-month pilot test. The pilot test will assess if inducing changes to the gradients in this area will facilitate groundwater flushing with lower chromium concentrations through these wells. Approval to perform the pilot test is pending. Once approval to conduct the pilot test is received, and sufficient data have been obtained to assess the potential benefits of limited or no extraction from wells EX-29, EX-30, and/or EX-37, PG&E will use the findings to inform a proposed longer-term strategy for addressing concentrations at MW-92C and MW-100C.

In May 2016, PG&E submitted the Lower Aquifer CSM Report (Arcadis 2016c). As required by the 2015 CAO (Water Board 2015), within 90 days of Water Board approval of the Lower Aquifer CSM Report, PG&E will prepare a feasibility assessment for remediation of Cr(VI) in the Lower Aquifer. However, as discussed above, PG&E does not recommend taking any additional remedial actions to address Lower Aquifer chromium concentrations at this time, other than conducting the proposed pilot test; therefore, there is no current need to conduct a feasibility assessment.

6 PLUME CLEANUP WITH ONGOING IRZ OPERATIONS

Cleanup of the higher concentration Cr(VI) plume is achieved via in situ treatment by injecting an organic carbon source (initially sodium lactate, now ethanol) to stimulate rapid growth of naturally occurring microbes in the subsurface that convert soluble Cr(VI) to relatively insoluble trivalent chromium (Cr[III]). Cr(VI) is reduced to Cr(III) directly by microbes creating anaerobic conditions or indirectly via chemical reduction by reduced iron and sulfide (produced under anaerobic conditions). Cr(III) is removed from groundwater by the precipitation of chromium hydroxides and iron-chromium hydroxides.

Figure 2-1 shows the location of the IRZ area, which historically consisted of the Central Area, SCRIA, and Source Area IRZs. Table 2-1 provides the general chronological descriptions for startup and operation of the Central Area, SCRIA, and Source Area IRZs. The following sections summarize the IRZ expansion projects completed during the four-year evaluation period, the ongoing operation of the IRZ systems, and the continued remedial progress achieved with the existing IRZs throughout the plume, as well as recommendations for operational improvements.

6.1 IRZ Expansion Projects 2015 through 2019

As discussed in Section 2, the IRZ remedy design and planned operations presented in the RTA (Arcadis 2014) included sequential expansions beginning in 2015, within the first few years (implemented in 2016 to 2017), and after approval of the HCP (i.e., potential startup in 2019). The 2015 expansion was completed and was first operated in 2016. The 2016 to 2017 planned expansion was completed and first operated in 2017. In 2017, PG&E consulted with and received approval from USFWS and CDFW to complete the 2018 Western IRZ expansion west of Fairview Road, with the installation of new infrastructure in the existing SCRIA IRZ and Source Area IRZ before approval of the HCP (USFWS 2017; CDFW 2017). The RTA did not account for expansions or construction in 2018 (Arcadis 2014). However, during adaptive operations evaluations, new projects in the higher concentration, more difficult-to-remediate areas were identified and implemented in 2018 and 2019.

Additional remedy enhancements planned in habitat in the western Central Area and SCRIA IRZs have not been implemented pending issuance of the HCP, Section 10 ITP, and Section 2081(b) ITP. The USFWS approved the HCP and issued the Section 10 ITP in 2019. The CDFW is finalizing the Section 2081(b) ITP in First Quarter 2020. The planned expansions for the 2019 on the western edge of the IRZ systems is also delayed pending approval of the required modifications to the 2016 Notice of Applicability of General Waste Discharge Requirements for IRZs and the Freshwater Injection System (2016 NOA; Water Board 2016a), as discussed in Section 2.3. During the Fourth Quarter of 2019, the WCB extraction wells were converted to IRZ injection wells to target Cr(VI) along and north of Community Boulevard. Operation of the converted IRZ wells began in the First Quarter of 2020. This conversion is generally consistent with the schedule presented in the RTA Arcadis 2014.

6.2 Central Area IRZ

Figure 2-1 shows the location of the Central Area IRZ system, constructed across a portion of the plume core (along Frontier Road) to remove Cr(VI) as groundwater migrates north through the IRZ. The original Central Area IRZ system, constructed in 2007, consisted of 12 remediation wells (CA-RW-01 to CA-RW-12) screened in the shallow zone (approximately 80 to 115 feet below ground surface) of the Upper

Aquifer and spaced 150 feet apart in an east-west line perpendicular to the direction of groundwater flow. The system was expanded with 21 additional wells, including coverage in the deep zone of the Upper Aquifer and extension of the line to the east and west in the shallow zone of the Upper Aquifer, during the Third and Fourth Quarters of 2012. With the additional wells, the spacing of injection wells in the shallow zone is approximately 75 feet, while the deep zone spacing is about 150 feet, although spacing varies along the line. Continuous operation of the expanded system began in November 2012. No further construction or expansions have been completed since 2012.

6.2.1 Remedial Implementation and Effectiveness

The expanded Central Area IRZ began operation in 2012. Operations typically comprise injection into a subset of the injection wells, with five to ten wells operated at a time. The active injection wells are rotated periodically to establish and sustain treatment across and downgradient of the Central Area IRZ. The primary focus areas during the last four years of operation were injection in the deep zone of the Upper Aquifer and in previously treated areas where the reducing capacity waned. Injection water is sourced from a combination of Central Area extraction wells and water extracted north of Barstow-Bakersfield Highway and imported to the Central Area.

TOC dosing concentrations over the last four years varied by injection well and ranged from 30 to 60 milligrams per liter (mg/L). The upper range of TOC (60 mg/L) was initiated in selected injection wells to improve downgradient reagent distribution and Cr(VI) treatment where previously operated injection wells had not treated target areas. Since the start of the expanded Central Area IRZ system, routine well rehabilitation has been incorporated into the operations and maintenance program. Throughout 2019, operation of the Central Area IRZ system was maintained at or greater than the planned injection flow rates and ethanol volumes per the 2019 operational plan (Arcadis 2019a), as presented in Table 2-3. Appendix A includes monthly groundwater recirculation and ethanol discharge volumes for 2019.

Figures 6-1 and 6-2 compare Cr(VI) isoconcentration contours in November 2007 (before IRZ startup) to contours documented during the Fourth Quarter of 2018 and the Fourth Quarter of 2019 for the shallow and deep zones of the Upper Aquifer, respectively³. Monitoring results from the Central Area IRZ monitoring network demonstrate effective treatment of Cr(VI) in the shallow and deep zones of the Upper Aquifer as groundwater passes through the IRZ. Areas requiring further evaluation are discussed below.

The clean water front in the shallow zone of the Upper Aquifer (white area) has been detected more than 3,000 feet downgradient of the IRZ (CA-MW-600-series wells), as shown on Figure 6-1. Reagent distribution and treatment have been observed and sustained in the central and eastern portions of the system through 2019. At the far western side of the system (labeled “Western Central Area Plume Extent” on Figures 6-1 and 6-2), concentrations of Cr(VI) at monitoring wells (e.g., CA-MW-302D, CA-MW-313R, CA-MW-401, CA-MW-402S, CA-MW-412D) have remained relatively elevated (e.g., Cr(VI) at concentrations of 50 µg/L) over the last four years, with occasional fluctuations. A subset of injection wells had been operated in the western extent of the Central Area IRZ in an attempt to influence IRZ treatment in this area. However, the groundwater flow direction has changed over time from northwesterly to a more northerly direction, making it difficult to treat the western extent of the plume with the current Central Area injection wells, which were designed based on the northwesterly flow direction. In addition, the

³ Appendix A includes complete Cr(VI) isoconcentration contours including data used for contouring during the Fourth Quarter of 2017 and the Fourth Quarter of 2019.

available screen intervals in existing wells are not at the appropriate depths to reach the impacts in the deep zone at CA-MW-302D.

On June 6, 2019, PG&E submitted the 2019 Western IRZ Expansion Basis of Design (Arcadis 2019c) with plans to delineate Cr(VI) in this area and expand the remedial system to address Cr(VI) in the western Central Area. The project was planned for 2019 but was not completed due to delays in obtaining CDFW and USFWS permits and Water Board permit revisions. The USFWS approved the HCP and issued the Section 10 ITP in 2019. The CDFW is finalizing the Section 2081(b) ITP permit in the First Quarter 2020. PG&E first discussed the revision to the IRZ NOA to allow the western IRZ expansion with the Water Board staff in a meeting on November 27, 2018. A request to modify the IRZ NOA was subsequently submitted to Water Board staff on March 18, 2019, and PG&E submitted a proposed modification memo on September 20, 2019 (Arcadis 2019f). Water Board revision of the IRZ NOA is still pending and further delaying construction of this project. PG&E plans to construct the proposed IRZ expansion as soon as practicable after the Water Board issues the IRZ NOA revision.

In the deep zone of the Upper Aquifer, treatment previously established near or downgradient of deep-screened Central Area injection wells was maintained. As shown on Figure 6-2, on the east side and in the middle of the system, the clean water front has migrated up to 1,600 feet downgradient in various flow paths, except for the eastern end of the system represented by CA-MW-315D and CA-MW-306D in the center. Upgradient injection wells have been operated in various configurations (e.g., different screen intervals, combinations of adjacent injection wells, TOC dosing modifications) to attempt to treat persistent Cr(VI) mass on the east end of the system near CA-MW-315D (labeled “Eastern Central Area” on Figure 6-2). Limited signs of treatment (such as reduced nitrate and chromium concentrations) have been observed; however, treatment has not been complete. As shown on Figure 2-6, remedy enhancements are planned in this area to target remaining Cr(VI) concentrations greater than 50 µg/L. On the west side of the system, treatment has been effective within the first 200 feet of the injection line but has not yet reached the western area represented by well CA-MW-302D (Figure 6-2). The planned western Central Area IRZ expansion project is anticipated to reduce concentrations at well CA-MW-302D (Figure 2-6).

6.2.2 Recommendations and Annual Operational Plan

Operation of the Central Area IRZ has primarily resulted in the establishment of a sustained Cr(VI) treatment zone in the deep zone of the Upper Aquifer, while residual treatment has generally continued in the shallow zone of the Upper Aquifer from previous injections. Continuing to periodically rotate operation of injection wells is recommended to maintain Cr(VI) reduction in previously treated areas and to reestablish treatment in areas with potential rebounding concentrations of Cr(VI). Cr(VI) concentrations will continue to be evaluated at target monitoring wells to determine if an increase in TOC dosing concentration is needed to improve reagent distribution and Cr(VI) treatment at downgradient locations. Routine well rehabilitation is also planned for 2020 to sustain injection and treatment performance. The 2020 operational plan for the IRZ system as a whole (April 2020 through March 2021) is summarized in Table 2-4 and discussed in Section 8.

Upon completion of the required modifications to the 2016 NOA (Water Board 2016a), the system will be expanded to address persistent Cr(VI) in the far western extent as summarized in the 2019 Western IRZ Expansion Basis of Design (Arcadis 2019c). To target remaining Cr(VI) concentrations greater than 50 µg/L on the eastern end of the system near CA-MW-315D, a Central Area remedy enhancement BOD will

be submitted in 2020 and included in the workplan for remedy enhancements that follows this four-year report.

6.3 SCRIA IRZ

Figure 2-1 shows the layout of the SCRIA IRZ system. The history of system expansions is summarized in Table 2-1. The SCRIA IRZ system was initially constructed in 2009. Progress in building out the remedy in several stages and treating the area between Community Boulevard and Frontier Road has been an ongoing process from 2009 to 2019. The stages of SCRIA buildout were:

- Initial installation in 2009 of 12 remediation wells in two parallel west-east trending injection lines (SC-IW-21 through SC-IW-26 and SC-IW-32 through SC-IW-37, with approximately 300-foot spacing; Figure 6-3);
- Late 2014 and early 2015: six injection wells (SC-IW-10 through SC-IW-15);
- March 2017: nine injection wells (SC-IW-16 through SC-IW-20, SC-IW-30, SC-IW-31, SC-IW-38, and SC-IW-39);
- Fourth Quarter 2017: seven injection wells (SC-IW-40 through SC-IW-46) west of Fairview Road;
- Third Quarter 2018: four extraction wells (EX-59, EX-60, EX-61, and SC-IW-15); and
- Fourth Quarter of 2018: five injection wells (SC-IW-60 through SC-IW-64), conversion of two wells to injection wells (EX-57 and EX-58), and installation of three extraction wells (EX-63 through EX-65), none of which were previously included in the RTA (Arcadis 2014).

6.3.1 Remedial Implementation and Effectiveness

Figures 6-3 and 6-4 compare Cr(VI) isoconcentration contours in October 2009 (before IRZ startup) to contours during the Fourth Quarter of 2017 and the Fourth Quarter of 2019 in the shallow and deep zones of the Upper Aquifer, respectively⁴. Proactive investigations to improve the understanding of plume conditions and continual performance evaluations have been used in a feedback loop to improve design methodology, identify difficult-to-treat areas, and enhance design remedy. During the last four years, injections were primarily focused on the deep zone of the Upper Aquifer on the southeast side of the system (labelled “Deep East SCRIA” on Figure 6-4) and in the shallow and mid-depth zones of the Upper Aquifer on the western side of the system. Cr(VI) concentration reductions have been observed in the vicinity and downgradient of active IRZ injection wells as shown by the white and light colored areas on Figures 6-3 and 6-4.

To optimize reagent distribution while minimizing biofouling in injection wells and conveyance piping across the SCRIA IRZ, the TOC dosing concentration was increased in May 2017 from 50 mg/L (2016 and early 2017) to 75 mg/L. The average TOC concentration was again increased in July 2018 to 100 mg/L to further improve reagent distribution and Cr(VI) treatment. Performance evaluation of the injectability of the SCRIA IRZ wells under various TOC dosing levels indicates that this dose generally optimizes the ability to distribute TOC without causing excessive biofouling. Operation of the SCRIA IRZ

⁴ Appendix A includes complete Cr(VI) isoconcentration contours including data used for contouring during the Fourth Quarter of 2017 and Fourth Quarter of 2019.

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system was maintained throughout 2019 at injection flow rates and ethanol volumes above the 2019 operational plan (Arcadis 2018b). Appendix A includes monthly groundwater recirculation and ethanol discharge volumes for 2019.

Design methodology was improved by evaluating the performance of injections conducted at the site through that time. A comparison of performance data indicated that organic carbon distribution and Cr(VI) reduction were optimal at a well spacing of 150 feet. The original design for the SCRIA in 2009 was constructed at a spacing of 300 feet, and this spacing had been assumed in the RTA plans. Starting with the 2015 SCRIA expansion, the more robust 150-foot spacing was used for expansions of the IRZ systems. The RTA planned installation of five injection wells in the SCRIA between 2015 and 2019. Based on the performance evaluation, this number of wells was increased by nine wells to 15 wells in the expansions completed between 2015 and 2017, as detailed in Table 2-2. The results of this design change have validated the effectiveness of the 150-foot well spacing. Dose-response wells and downgradient monitoring wells placed in between injection wells, including SC-MW-13S, SC-MW-42S/D, MW-180RS/D, and MW-178S/D, have verified establishment of Cr(VI) treatment with this improved design.

Performance evaluations also revealed areas where Cr(VI) treatment was not proceeding as expected in in some portions of the SCRIA. As shown on the middle 2017 panel of Figure 6-4 (labelled “Eastern SCRIA”), Cr(VI) concentrations were not declining and remained above 100 µg/L along Summerset Boulevard (SC-MW-02D and SC-MW-03D), while the model predicted that treatment should be progressing. In addition, the area of elevated concentrations that was initially above 1,000 µg/L at SC-MW-26D in the deep eastern SCRIA, treatment progress was slow, and concentrations remained above 500 µg/L in 2017, as shown on the middle panel of Figure 6-4. Proactive investigations in this area with persistent Cr(VI) concentrations were completed in 2017 and 2018 to improve the understanding of plume conditions.

The results of these proactive investigations revealed that groundwater was flowing in the vicinity of SC-MW-02D and SC-MW-03D but at a slow rate, that the deep zone of the aquifer in this area exhibits semi-confined behavior, and that Cr(VI) was present in groundwater at concentrations greater than 1,000 µg/L in a larger area upgradient of SC-MW-26D than previously understood (Arcadis 2018a and Arcadis 2019c). Figure 1 (included in Appendix A) from the Basis of Design for the Deep SCRIA East In-Situ Reactive Zone near EX-57 and EX-58 (Arcadis 2018d) shows the expanded area of elevated concentrations, as indicated by the Cr(IV) concentrations 1,000 and 1,100 µg/L detected in the deep screen intervals of new wells EX-57 and EX-58, respectively.

The first remedial enhancement designed based on the investigation results was installation of three new extraction wells (EX-59 through EX-61) and conversion of existing injection well SC-IW-15 to an extraction well. Construction of this system was beyond what was originally planned for the remedy in the RTA. Extraction operations began during the Third Quarter of 2018 to enhance clean water flushing of the Cr(VI) plume east of Summerset Road in the deep zone of the Upper Aquifer. The operation of these extraction wells proved effective, with the 100 µg/L plume previously detected at SC-MW-02D and SC-MW-03 retreating to Summerset Road, as shown on the Fourth Quarter 2019 panel on Figure 6-4 (labelled “Eastern SCRIA”).

The second remedial enhancement designed based on the investigation targeted the expanded 1,000 µg/L area as detailed in the Basis of Design for the Deep SCRIA East In-Situ Reactive Zone near EX-57 and EX-58 (Arcadis 2018d). This remedy enhancement proactively targeted treatment of these elevated

Cr(VI) concentrations that appear relatively difficult to treat (Arcadis 2018d) through a dense network of recirculation wells. During the Fourth Quarter of 2018, five injection wells (SC-IW-60 through SC-IW-64) and three extraction wells (EX-63 through EX-65) were installed, and two wells (EX-57 and EX-58) were converted to injection wells. None of these wells were previously considered in the RTA (Arcadis 2014).

A subset of these injection wells has operated since April 2019. While decreases have been observed at nearby monitoring wells, Cr(VI) concentrations are also fluctuating. The fluctuating concentrations may be due to the operation of nearby extraction wells (EX-63 through EX-65), which are drawing high Cr(VI) concentrations in this area towards them, and the complexity of the geologic conditions in this area (labelled “Deep East SCRIA” on Figure 6-4). Shallow monitoring wells in this area have exhibited decreases in Cr(VI) concentrations, likely due to operation of the extraction wells in conjunction with deep zone injection operations. Based on these trends, it appears that treated water injected into the deep zone is moving into the shallow zone, which is resulting in incomplete treatment of the deep zone. Injection wells will be reconfigured to inject into both shallow and deep screens in 2020 to facilitate flushing of treated water through the deep zone.

Investigation was also completed during installation of the SCRIA west of Fairview Road in 2018. Results from the sampling of injection well SC-IW-40 and new monitoring well SC-MW-44S revealed a greater western extent of Cr(VI) above 100 µg/L than was previously understood in the western SCRIA, as shown by comparison of the western extent of the plume in the shallow zone between the 2017 and 2019 panels on Figure 6-3 (labelled “Western SCRIA Plume Extent”).

6.3.2 Recommendations and Annual Operational Plan

Operation of a subset of SCRIA IRZ injection wells will continue in 2020, targeting the remaining high chromium concentrations in the deep zone of the Upper Aquifer in the southeastern area and the shallow and mid-depth zones of the Upper Aquifer in the western area of the SCRIA IRZ. Injection wells will continue to be dosed with a TOC concentration of 100 mg/L. Routine well rehabilitation is planned for 2020 to sustain injection and treatment performance. The 2020 operational plan for the IRZ system as a whole (April 2020 through March 2021) is summarized in Table 2-4 and discussed in Section 8.

The RTA planned for expansion of the SCRIA IRZ in the northeast in early 2019. This project has been constrained and delayed because it is within wildlife habitat and the HCP, Section 10 ITP, and Section 2081(b) ITP wildlife agency permits were delayed past the May 2018 assumption of approval in the RTA. The USFWS approved the HCP and issued the Section 10 ITP in 2019. As such, this project is recommended to proceed in 2020, in line with the updated modeling assumptions presented in Section 3.2.

Proactive expansion of the IRZ to treat the expanded western extent of the plume in the shallow zone was proposed in a BOD submitted on June 6, 2019. Updated groundwater modelling conducted as part of this four-year assessment (Section 3.2) indicated that layout of injection wells proposed in the BOD will result in a gap in Cr(VI) treatment in this area and extend the time required to treat the 50 µg/L plume several years beyond 2025. As such, the workplan that follows submittal of this report will provide a plan for additional infrastructure in this area within the constraints of property accessibility to improve treatment and treat the 50 µg/L plume by 2025. Note, this proposed project is within wildlife habitat and was delayed due to wildlife agency permitting issues as described above for the northeastern SCRIA project, but the final necessary Section 2081(b) ITP is expected to be approved in First Quarter 2020. This project also requires a modification of the IRZ NOA to expand the area of allowable injection. As mentioned above in Section 6.2.1, PG&E has been discussing the revision to the IRZ NOA to allow the

western IRZ expansion since late 2018. Water Board revision of the IRZ NOA revision is still pending and further delaying construction of this project, and permitting constraints may become a rate limiting factor to achieving treatment of the 50 µg/L plume by 2025.

6.4 Source Area IRZ

Figure 2-1 shows the layout of the Source Area IRZ system, and the history of system expansions is summarized in Table 2-1. The Source Area IRZ was originally constructed in 2008. Progress in building out the remedy in several stages has been ongoing from 2008 to 2019. The stages of Source Area IRZ buildout were:

- May 2008 installation of four extraction wells (SA-RW-01 through SA-RW-04) and 12 injection wells (SA-RW-05 through SA-RW-16).
- May 2011: installation of northern line of injection wells (SA-RW-17 through SA-RW-21), conversion of the four 2008 extraction wells to injection wells, and installation of three extraction wells further north (SA-RW-22, SA-RW-23, and SA-RW-25). This line of wells is labeled “northern line” on Figures 6-5 and 6-6.
- April 2015: installation of 13 new injection wells (SA-RW-26 through SA-RW-38) in April 2015, including in-fill wells to decrease well spacing in the northern line (SA-RW-26 through -34), SA-RW-38 near the compressor station surface impoundments, and wells in the southwestern Source Area (SA-RW-35 through -37).
- 2016: proactive investigation of the southern portion of the plume to inform the next phase of system expansion.
- October 2017: installation of 10 injection wells (SA-RW-39 through SA-RW-48). The 2017 Source Area IRZ installation included a closer well spacing than the seven wells included in the RTA (Arcadis 2014) and an additional line of injection wells, resulting in installation of four wells more than planned in the RTA (Arcadis 2014). Two wells planned in the RTA (Arcadis 2014) for installation within the active Hinkley Compressor Station were not installed at that time pending investigation of Cr(VI) concentrations near MW-01 (Table 2-2).
- March 2018: installation of three injection wells (SA-RW-54 through SA-RW-56) west of SA-RW-37 and an additional extraction well (EX-54). Two additional injection wells (SA-RW-50 and SA-RW-51) were installed in the northern line.
- Fourth Quarter of 2019: installation of extraction well SA-RW-57. Regular operation of SA-RW-57 is anticipated to begin during the Second Quarter of 2020 or sooner.

In total, since 2015, an additional 10 injection wells and two extraction wells have been constructed in the Source Area IRZ beyond those planned in the RTA (Table 2-2).

The 2019 Source Area IRZ operations for 2019 are summarized in comparison with the 2019 operational plan in Table 2-3. Appendix A includes monthly groundwater recirculation and ethanol discharge volumes for 2019. Operational flow rates and ethanol volumes for the Source Area IRZ were within or above the operational planned ranges in 2019 with the goal of hydraulically influencing groundwater with the highest Cr(VI) concentrations.

6.4.1 Remedial Implementation and Effectiveness

The Source Area south and just north of Community Boulevard contained the highest baseline Cr(VI) concentrations on site (Figures 3-2 and Figure 3-3). Areas with concentrations greater than 1,000 µg/L recently (and more than 9,000 µg/L historically) have been observed (Figures 6-5 and 6-6). Remedial performance over the last four years has been achieved through diligence of system operations, IRZ expansions, enhancements beyond what was planned in the RTA, and proactive investigations. These activities have improved the understanding of plume conditions. During this four-year period, injections focused on the highest chromium concentration area of the deep zone of the Upper Aquifer in the northern Source Area and other portions of the shallow and deep zones of the Upper Aquifer with chromium concentrations greater than 100 µg/L across the Source Area. As a result of these operations, treatment has steadily progressed and become well established across much of the Source Area. However, achievement of 50 µg/L concentrations in this portion of the plume is slower in areas that initially contained Cr(VI) concentrations greater than 1,000 µg/L before initiating IRZ operations. In addition, a portion of the Source Area originally planned for treatment has not been targeted to date due to dewatering conditions and limited saturated thickness due to the ongoing drought (Figure 6-5, See Section 4).

In the shallow zone (Figure 6-5), Cr(VI) concentrations were treated to less than 50 and 10 µg/L in the northeast Source Area progressing from the northern line to north of Community Boulevard. Cr(VI) treatment to less than 10 and 50 µg/L has also been well established and bisects the Source Area plume in the south from the 2018 Western IRZ expansion wells SA-RW-54 through SA-RW-56 in the west, through the 2017 Source Area IRZ in the central Source Area (SA-RW-39 through SA-RW-42), to the east at monitoring well SA-MW-35S. Injections in the shallow zone since 2011 have also resulted in a clean water front immediately downgradient of the northern line on the west (SA-RW-17 in the west through SA-RW-29 in the east). In response to IRZ operations, Cr(VI) concentrations previously greater than 1,000 µg/L across much of the area have declined to maximum concentrations of less than 300 µg/L to the south of Community Boulevard.

In the deep zone (Figure 6-6), notable treatment has been established in the central Source Area from operation of the 2017 Source Area IRZ (SA-RW-39 through SA-RW-42) and across the entire northern line SA-RW-26 in the west to SA-RW-21 in the east. Evidence of treatment downgradient from these locations in higher concentration areas has been observed but is occurring more slowly than that observed in the shallow zone (Figure 6-5).

Although Cr(VI) concentrations have decreased below 50 µg/L across much of the shallow and deep zones of the Upper Aquifer where injection wells have operated over the last four years, slower progress is occurring in areas of baseline Cr(VI) concentrations greater than 1,000 µg/L. In these areas, Cr(VI) concentrations are decreasing steadily, but are taking longer to reach 50 µg/L than areas with lower initial concentrations. One example is in the shallow zone in the northwest-trending area of chromium concentrations greater than 1,000 µg/L historically extending from MW-20 northwest through SA-MW-06S (shown on the 2011 panel on Figure 6-5). Cr(VI) concentrations in this area have been reduced to less than 3.1 µg/L proximal to the injection transect at locations like SA-MW-01S and SA-MW-02S. Farther downgradient at SA-MW-06S, concentrations have significantly decreased by an order of magnitude but are not yet less than 50 µg/L (2019 panel on Figure 6-5). In the deep zone, baseline concentrations greater than 1,000 µg/L were observed in the northeast Source Area from PMW-03 north to SA-MW-10D and east towards SA-MW-20D. This area includes the well historically exhibiting the highest Cr(VI) concentration on site with concentrations higher than 9,000 µg/L SA-MW-05D. Cr(VI) concentrations in

this initially high concentration area have significantly declined by an order of magnitude; however, the progress is slower than initially anticipated, and Cr(VI) concentrations are still greater than 50 µg/L.

Proactive investigations identified additional areas that require treatment and, in conjunction with water level data collected during monitoring, identified areas where the shallow zone is dewatering due to drought that are difficult to treat at this time. The following paragraphs first discuss characterization of additional areas of plume under the compressor station that began in 2017 and then discuss the characterization of dewatered areas identified from investigations conducted in 2016 and 2018.

In 2017, PG&E initiated an additional investigation into elevated Cr(VI) concentrations beneath the compressor station to evaluate the potential reasons that Cr(VI) concentrations have rebounded at monitoring wells MW-01 after IRZ injections are suspended. Well MW-01 is located northeast of the high concentration area identified through the 2017 investigation under the compressor station (Figure 6-5, bottom panel). The initial investigation in 2017 indicated that elevated Cr(VI) concentrations are present upgradient to the southwest of MW-01 at two locations (SA-MW-39S/D and SA-MW-40S/D), beyond the current extent of remedial infrastructure. Two additional monitoring well pairs (SA-MW-42S/M and SA-MW-43S/M) were installed as part of further investigation in 2018 to define the Cr(VI) distribution to the south and southwest of MW-01. Data collected to date have revealed an area of Cr(VI) concentrations greater than 500 µg/L within the shallow zone upgradient of MW-01 at SA-MW-39S and SA-MW-39D, which extends as far south as SA-MW-43S and SA-MW-43M (see southwest portion of bottom panel on Figure 6-5). Cr(VI) concentrations greater than 50 µg/L at MW-17 are also likely sourced from untreated mass in the newly identified area.

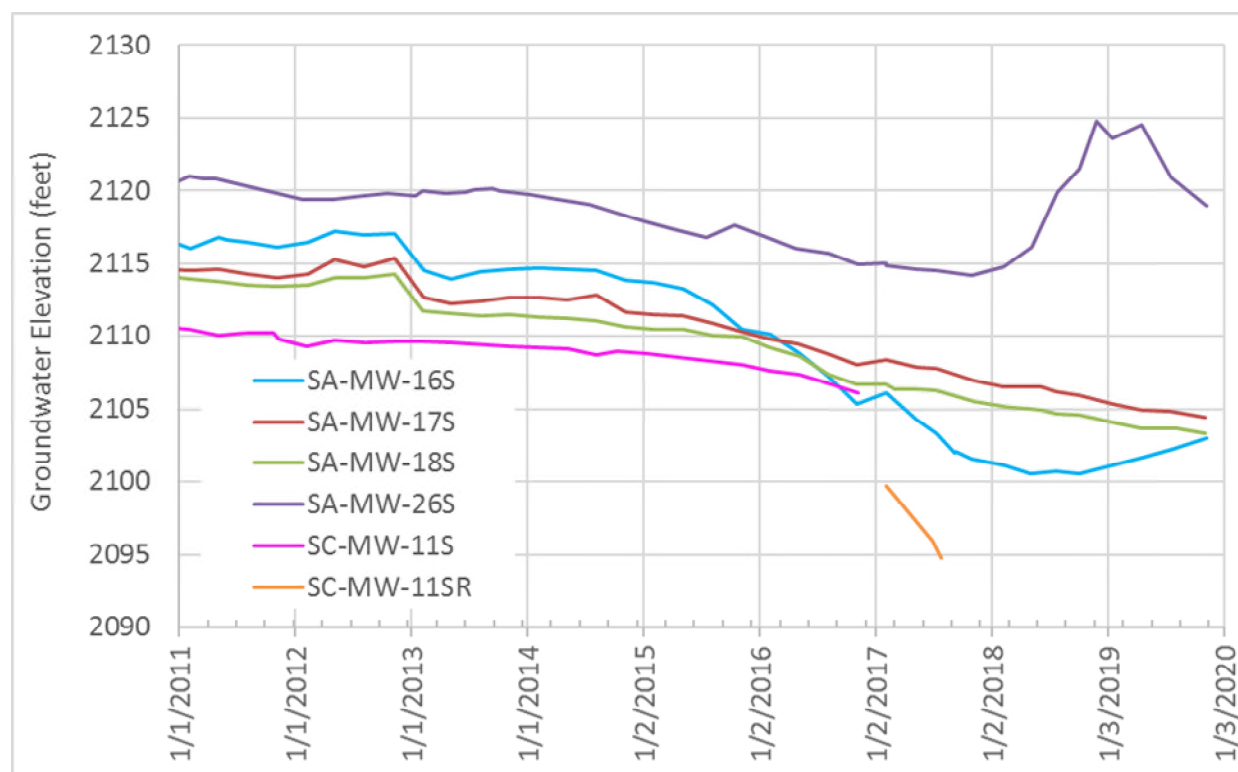
To address this residual Cr(VI), a remedy enhancement was proposed in a design notification submitted in October 2019 (Arcadis 2019e). For the first phase of installation, an extraction well within the compressor station (SA-RW-57) was constructed during the Fourth Quarter of 2019. Extraction at SA-RW-57 is anticipated to begin in April 2020. Monitoring data obtained during extraction at SA-RW-57 will provide additional insight into mobility of the mass in this area and groundwater gradients. These data will be reviewed to select the most appropriate locations for one to three additional IRZ injection wells in the second phase of implementation. Additionally, once extraction at SA-RW-57 is initiated, it is anticipated that IRZ injection at wells southeast of the high concentration area (SA-RW-43/44/45) will be resumed to treat Cr(VI) remaining in the SA-MW-34S and MW-17 area.

Drought conditions have progressed since 2011 (Section 4), resulting in steadily declining groundwater levels across the Hinkley Valley. The declining groundwater levels are particularly severe in the western portion of the Source Area, where the aquifer was already thinner than other areas of the plume before drought conditions began. The shallow zone in the western Source Area and extending north into the western SCRIA just north of the intersection of Community Boulevard and Fairview Boulevard has become dewatered (Figure 6-5). Monitoring well pair MW-220S/D was installed as part of the proactive investigation conducted in the Source Area in 2016 to evaluate the extent of Cr(VI) impacted groundwater west of SA-MW-16S/D and Fairview Road. After the well at MW-220S was constructed, it was discovered that the shallow interval at MW-220S was dry. This dry well bounds the extent of the western shallow zone Cr(VI) contaminated groundwater, resulting in retraction of the western plume extent in this area (2011 panel versus 2017 panel on Figure 6-5).

As discussed above and in the BOD for the 2018 western IRZ expansion (Arcadis 2017b) and shown in the hydrograph for shallow zone monitoring wells in Exhibit 6-1 below, groundwater levels in monitoring wells throughout the western shallow zone in the Source Area and southwestern SCRIA are on a declining trend. Decreases of more than 10 feet in some locations have been observed since 2011

(when the last significant Mojave River flow occurred). The increasing groundwater elevation trend observed at SA-MW-26S from early 2018 through early 2019 coincides with injections into SA-RW-54 through SA-RW-56 (Figure 6-5). Due to the declining water levels, the 2018 western expansion did not include the two westernmost injection wells planned in the RTA near dry well MW-220S (Arcadis 2017b). The 2018 western expansion did include SA-RW-53 (Figure 6-5). However, when SA-RW-53 was installed and screened across the shallow zone, it did not yield water. Under current conditions, the shallow zone in this western area near the intersection of Community Boulevard and Fairview road is very thin, with an estimated saturated thickness of less than a few feet throughout the hashed area shown on the 2019 panel of Figures 2-6 and 6-5.

Exhibit 6-1. Hydrographs for shallow zone of the upper aquifer monitoring wells along Fairview Road in the Source Area



6.4.2 Recommendations and Annual Operational Plan

Operation of the Source Area IRZ system will continue in 2020, rotating primarily among wells in the northern and southern Source Area. Operation of a subset of the available injection wells is recommended in areas where additional treatment is needed with periodic rotations of well locations and/or screened intervals as areas are treated. The cumulative Source Area IRZ injection flow rate is expected to decline over time in 2020 as treatment downgradient of existing infrastructure is established. Subsequently, injections are expected to be focused north of Community Boulevard at the WCB IRZ wells as discussed below. Routine well rehabilitation is planned to continue in 2020 to sustain injection rates and treatment performance. The 2020 operational plan for the IRZ system as a whole (April 2020 through March 2021) is summarized in Table 2-4 and discussed in Section 8.

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Operations, investigations, and remedy enhancements are planned in four key areas to continue progress toward the 50 and 10 µg/L timeframe requirements:

- Continued operation and injection well rotations in the northern line of injection wells to continue the steady but slow progress in reducing Cr(VI) concentrations that were initially greater than 1,000 µg/L to less than 50 µg/L by 2025. Concentration trends to date and updated groundwater modeling results presented in Section 3.2 indicate that continued operations in this area can achieve the 50 µg/L target by 2025, although there is some uncertainty on the endpoint and, as such, careful attention will be paid to operations and progress in this area.
- Operation of the new extraction well SA-RW-57 under the compressor station to begin treatment in the area of Cr(VI) concentrations above 500 and 1,000 µg/L characterized by proactive investigations in recent years (shallow panel, Figure 2-6). In addition to SA-RW-57, one to three additional injection wells are currently planned for installation in 2021 in this area to target elevated Cr(VI) concentrations beneath the compressor station. The number of IRZ wells will be refined through monitoring while extraction well SA-RW-57 is operated in 2020 to extract mass from this area, as discussed in Section 6.3.1.
- Convert extraction wells EX-40 and EX-43 to EX-49 along West Community Boulevard to injection wells and begin injection of ethanol (WCB IRZ). This project will target the area that currently contains the highest Cr(VI) concentrations at the site north of Community Boulevard in the shallow zone with injection (Figure 2-6).
- Persistent Cr(VI) concentrations at SA-SM-02S in conjunction with Cr(VI) concentration increases during periods between injections at PMW-05 indicate that an area of persistent, elevated Cr(VI) concentration is present underneath the compressor station surface impoundments that was not treated by previous upgradient injections at SA-RW-08 through SA-RW-10. Updated groundwater modeling results presented in Section 3.2 highlight the potential for this residual mass to prolong the treatment timeframe to reach 50 µg/L plume reduction requirements. To inform a plan to address this residual mass, PG&E recommends to proceed with an additional northern Source Area investigation to characterize the distribution and extent of Cr(VI) mass in this area (shallow panel, Figure 2-6). This investigation will be included in the workplan that follows this four-year assessment.

Additional infrastructure is not planned at this time to target the western portion of the shallow zone near the intersection of Community Boulevard and Fairview Road (shown in hashed area on Figure 2-6), given the limited saturated thickness in this area and ongoing dewatered conditions due to the drought. The need for additional remedial infrastructure in the western shallow zone will be reassessed should drought conditions end and water levels in this area recover.

7 EVALUATION OF MONITORING FREQUENCY

The 2015 CAO requires review of the monitoring frequency of monitoring wells used to contour the plume boundary determine whether the sampling frequency for an individual well should be changed each year in the Annual Cleanup Status and Effectiveness Report (Water Board 2015). The decision trees shown on Figure 8.1 of MRP Attachment B and Figure 8.2 of MRP Attachment C (Water Board 2015) were used to determine if a change in monitoring frequency is warranted for monitoring wells located in the Southern Plume Area and the Northern Plume Area, respectively. The sampling frequency analysis is presented in Appendix C.

The changes to the sampling frequencies in 2020 are summarized as follows:

- The sampling frequency for 11 monitoring wells changed from quarterly to semi-annually given the history of concentrations below 3.1 µg/L or stable or decreasing Cr(VI) concentration trends.
- The sampling frequency for 13 monitoring wells changed from semi-annually to annually given the history of concentrations below 3.1 µg/L or stable or decreasing Cr(VI) concentration trends.
- The sampling frequency for one monitoring well changed from annually to biennially given the history of non-detect concentrations or decreasing or stable Cr(VI) concentration trends.
- The sampling frequency for four wells changed from semi-annually to quarterly, and for ten wells changed from annually to semi-annually given increasing Cr(VI) concentration trends or the highest concentration in the well cluster.

8 ANNUAL OPERATIONAL PLAN

Table 2-4 provides the operational plan for April 2020 through March 2021 for all remedial systems at the site.

The monthly average flow rates of extracted water applied to the ATUs in Table 2-4 are similar to those documented in previous years. The planned rates assume flows sufficient to maintain hydraulic containment during winter months and also vary seasonally to support crops given changes in temperature and evapotranspiration rates throughout the year. Actual application rates may vary with implementation based on cropping and weather patterns.

Due to the interconnectivity of the IRZ systems, a wholistic IRZ system-wide (inclusive of the Central Area, SCRIA, WCB, and Source Area IRZs) range of monthly average flow rates and ethanol discharge volumes is provided. The planned total IRZ system flow rate is 300 to 350 gpm, with a monthly ethanol discharge volume of 940 to 3,670 gallons. The operational plan flow rates are listed as a range to accommodate well rehabilitation, well rotations, and other maintenance. Using a range of ethanol volumes allows refinement of TOC concentrations (increases or decreases) to achieve Cr(VI) treatment while maximizing flow rates and maintaining well health. Using a range of flow rates also allows for shutting down injection wells once treatment is achieved and sustained in an area rather than continuing to operate a well simply to maintain flow rates/ethanol volumes.

As required by the 2015 CAO (Water Board 2015), the Water Board will be notified if operational changes are planned that will decrease individual system flow rate by 10 percent below the lower bound of the planned operational range for that remedial system.

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TABLES



TABLES



Table 2-1
Chronological Summary of Remedial System Startup, Cumulative Number of Wells, and
Combined Annual Average Extraction Rates
Four-Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Period	Key Remedial System Event	IRZ Wells ^a	Freshwater Injection Wells	Extraction Wells	Combined Extraction Rate ^b (gpm)
1992 – 2001	Operation of East and Ranch LTUs.	--	--	32	744 ^c
September 2004	Began operations for DVD LTU.	--	--	2	46
November 2007	Began Central Area IRZ operations.	12	--	4	284
April – May 2008	Startup of the Source Area IRZ system.	28	--	7	334
October 2009	Began SCRIA IRZ operation. Northwest Area extraction wells used for SCRIA IRZ supply.	40	--	9	334
March 2010	Began localized injection for NWFI System.	40	4 ^d	9	476
March – June 2011	Began operations at Gorman, Cottrell, and Ranch ATUs.	40	5 ^d	23	1,001
April 2011	Began expanded Source Area IRZ system.	49	5 ^d	23	1,001
November 2012	Began expanded Central Area IRZ system and manganese mitigation system operations.	70	5 ^d	33	1,190
April 2013	Began Yang ATU operations.	70	5 ^d	33	1,157 ^d
August 2013	Suspended discharge to the Yang ATU and completed construction of the Yang ATU expansion.	70	5 ^d	34	1,157 ^d
October – December 2013	Restarted irrigation at the Yang ATU. Installed 68 new Upper Aquifer monitoring wells and two new extraction wells at the Yang ATU (starting operation in April 2014).	70	5 ^d	34	1,250 ^e
March 2014	Began operating injection wells IN-03R and IN-06 on March 6, 2014. IN-03 may be used when IN-03R is shut down for maintenance.	70	6 ^d	34	1,111 ^f
May 2014	Began Western Area groundwater extraction with the operation of EX-36.	70	6 ^d	37	1,111 ^f

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Period	Key Remedial System Event	IRZ Wells ^a	Freshwater Injection Wells	Extraction Wells	Combined Extraction Rate ^b (gpm)
September 2014	Expanded the Ranch ATU with the addition of 21 acres.	70	6	37	1,208 ^g
2015	Began operation of the following systems: <ul style="list-style-type: none"> • April: Expanded Source Area system. • May: Expanded SCRIA IRZ system. • June: Community East ATU. • September: Northern portion of the Fairview ATU. • November: DVD West Pivot. • December: DVD East Pivot. The new DVD acreage is 64 acres, including the existing DVD Westfield. 	88	6	58	1,100 ^h
2016	Began operation of southern portion of the Fairview ATU.	88	6	58	1,300 ⁱ
October – December 2016	Installed nine new injection wells in the SCRIA IRZ system.	97	6	58	
2017	Installed one new extraction well and began operation.	97	6	59	1,179 ^j
October 2017 – February 2018	Expanded the following systems: <ul style="list-style-type: none"> • Source Area IRZ system – installed 12 injection wells. • Western IRZ – installed 11 new injection wells and one extraction well. 	120	6	60	1,179 ^j

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Combined Annual Average Extraction Rates
Four-Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Period	Key Remedial System Event	IRZ Wells ^a	Freshwater Injection Wells	Extraction Wells	Combined Extraction Rate ^b (gpm)
2018	<p>Expanded and/or constructed the following systems, operation to begin in 2019:</p> <ul style="list-style-type: none"> Northern Containment: Installed one extraction well. Community East ATU Extraction: installed five new extraction wells and converted one SCRIA IRZ injection well to an extraction well; operation began in 2018. Deep SCRIA East IRZ: installed seven injection wells and three new extraction wells; operation to begin in 2019. Southeastern extraction: installed two extraction wells and eight piezometers in the southeast; operation began in 2019. 	126	6	72	1,368 ^k
2019	<p>Expanded and/or constructed the following systems, operation to begin in 2020:</p> <ul style="list-style-type: none"> Western Community Boulevard Extraction/IRZ Conversion: Converted eight ATU extraction wells to IRZ wells and connected to SCRIA IRZ system; operation will begin in 2020. Southern Source Area IRZ: Installed one IRZ well within the Hinkley Compressor Station to be used for extraction; piping construction and operation will begin in 2020. 	135	7	66	1475 ^l

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Chronological Summary of Remedial System Startup, Cumulative Number of Wells, and
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Notes:

- ^a Recirculation wells for IRZ.
- ^b Combined annual average extraction rates for ATUs and Northwest Area extraction wells.
- ^c Annual Report Evaluation of Corrective Action for Year 2000-2001 (Alisto Engineering Group 2001).
- ^d First half of 2013.
- ^e Second half of 2013.
- ^f First half of 2014.
- ^g Second half of 2014.
- ^h Combined rates are calculated from the Fourth Quarter 2015 Monitoring Report for the In Situ Reactive Zone and Northwest Freshwater Injection Projects (Arcadis 2016a) and Fourth Quarter of 2015 Agricultural Treatment Units Monitoring Report (Arcadis 2016b).
- ⁱ Combined rates are calculated from the Fourth Quarter 2016 Monitoring Report for the In Situ Reactive Zone and Northwest Freshwater Injection Projects (Arcadis 2017a) and Fourth Quarter of 2016 Agricultural Treatment Units Monitoring Report (Arcadis 2017b).
- ^j Combined rates are calculated from the Fourth Quarter 2017 Monitoring Report for the In Situ Reactive Zone and Northwest Freshwater Injection Projects (Arcadis 2018a) and Fourth Quarter of 2017 Agricultural Treatment Units Monitoring Report (Arcadis 2018b).
- ^k Combined rates are calculated from the Fourth Quarter 2018 Monitoring Report for the In Situ Reactive Zone and Northwest Freshwater Injection Projects (Arcadis 2019a) and Fourth Quarter of 2018 Agricultural Treatment Units Monitoring Report (Arcadis 2019b).
- ^l Combined rates are calculated from the Fourth Quarter of 2019 Agricultural Treatment Units Monitoring Report (Arcadis 2020a).

Acronyms and Abbreviations:

-- = not applicable; remedial systems not operating
 ATU = Agricultural Treatment Unit
 DVD = Desert View Dairy
 gpm = gallons per minute
 IRZ = In Situ Reactive Zone
 LTU = Land Treatment Unit
 NWFI = Northwest Freshwater Injection
 SCRIA = South Central Reinjection Area

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Table 2-2
Summary of Key Differences between Planned and Actual Remedy Implementation
Four-Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Calendar Year	Remedy Year	System	Item	Plan	Actual	Notes
Remedy Infrastructure (e.g., remedial well installation)						
2015	prior to CAO	SCRIA IRZ (SC-IW-10 to SC-IW-15)	Installation of injection wells ¹	2	6	The actual SCRIA expansion completed in 2015 was more robust than in the RTA (Arcadis 2014).
2015	prior to CAO	Source Area IRZ (SA-RW-26 to SA-RW-38)	Installation of injection wells ¹	15	13	The actual Source Area expansion, completed in 2014 and 2015, consisted of fewer wells than the RTA due to the results of the investigation completed in the southwest Source Area. Results of the investigation bound the western extent of the plume along the access road north of the compressor station and indicated that the last two injection wells in this transect would be better placed to the north, which is in habitat. Those two wells were planned to be constructed after the HCP is approved, but were incorporated into 2017-2018 Western IRZ installation.
2016-2017	2	SCRIA IRZ (SC-IW-16 to SC-IW-20 and SC-IW-30, SC-IW-31, SC-IW-38, and SC-IW-39)	Installation of injection wells ¹	3	9	The actual SCRIA expansion completed in 2016 was more robust than planned in the RTA (Arcadis 2014).
2017	2	Southeast Source Area (SA-RW-39 to SA-RW-48)	Installation of remedial wells ¹	6	10	The actual southeast Source Area expansion, completed in 2016 and 2017, consisted of more wells than in the RTA. An additional line of injection wells was added, and more wells were included within the previously planned lines to the south and the east. The wells to the west on the compressor station were not installed and are pending completion of investigation activities in that area.
2017	2	Northern Extraction Optimization (EX-53)	Installation of extraction well ¹	0	1	This extraction optimization project was completed ahead of schedule. Northern extraction optimization construction was not planned until remedy year 10 in the RTA.
2017-2018	2-3	Western IRZ (Source Area SA-RW-53 to SA-RW-56; EX-54; SCRIA SC-IW-40 to SC-IW-46)	Installation of remedial wells ¹	0	12	This project was expedited in advance of the HCP and ITP through consultation with the wildlife agencies. Note that SA-RW-53 yielded no water and is not being connected to the remedial system.
2017-2018	2-3	Source Area IRZ (SA-RW-50 and SA-RW-51)	Installation of injection wells within the existing northern line ¹	0	2	This project was initiated to respond to residual Cr(VI) concentrations north of the existing line of the Source Area and was beyond the plan in the RTA. One well (SA-RW-51) was added at the request of the Water Board.
2018	3	Eastern Community ATU Extraction (EX-55, EX-56, EX-59, EX-60, EX-61, SC-IW-15)	Installation of extraction wells; conversion of existing injection well to extraction well ¹	0	6	This extraction optimization and remedial enhancement project was beyond what was evaluated in the RTA.
2018	3	Deep SCRIA East IRZ (EX-63 to EX-65; SC-IW-60 to SC-IW-64; EX-57 to EX-58)	Installation of remedial wells and monitoring wells; conversion of monitoring wells to injection wells ¹	0	10	This remedial enhancement project was beyond what was evaluated in the RTA.
2018	3	Northern Extraction (EX-62)	Installation of extraction well ¹	0	1	This extraction optimization project was completed ahead of schedule. Northern extraction optimization construction was not planned until remedy year 10 in the RTA.
2018	3	Southeastern Extraction (EX-66 and EX-67)	Installation of extraction wells ¹	0	2	This project was in addition to the remedial infrastructure evaluated in the RTA (Arcadis 2014).
2019	4	Western Community Boulevard Extraction/IRZ Well Conversion	Conversion of extraction wells to IRZ wells ¹	6 converted	8 converted	This project converts extraction wells to IRZ injection wells along Community Boulevard in the northern Source Area / southern SCRIA IRZ. Construction was completed in 2019 so that operation could begin in remedy year 5, as evaluated in the RTA. The RTA evaluated conversion of a set of six wells across the plume, while the project as implemented converted eight wells in the western portion of the plume to address the area of greatest remaining mass.
2019	4	Southern Source Area (SA-RW-57)	Installation of remedial wells ¹	2 remaining wells on Compressor Station from 2017 Southeast Source Area Expansion	1	This project continues expansion in the southern Source Area that began in 2016-2017 and was evaluated in the RTA for year 2. Investigation within the Hinkley Compressor Station was completed in 2017-2018 before design refinement. One well (SA-RW-57), to be operated first as an extraction well, was installed for Phase I of the expansion within the Hinkley Compressor Station, compared to two injection wells evaluated in the RTA.
2019	4	Western IRZ	Installation	9	see above 2017-2018	The western IRZ expedited in advance of the schedule planned in the RTA (see above). In the SCRIA and southern Source Area portion of this project, the well installation was more robust than planned. In the northern source area two wells planned in the were not installed due to dry conditions.

Table 2-2
Summary of Key Differences between Planned and Actual Remedy Implementation
Four-Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Calendar Year	Remedy Year	System	Item	Plan	Actual	Notes
Operations and Maintenance						
2015	prior to CAO	Hydraulic Control System, Southern Plume North of Barstow-Bakersfield Highway	Optimization by shifting extraction to the south	Year 10	Prior to Year 1	Improvements to northern hydraulic control system in 2015 well ahead of schedule.
2016	1	Hydraulic Control System, Southern Plume North of Barstow-Bakersfield Highway	Operate at monthly target flow rates ²	530 to 1,190 gpm extraction	641 to 1,187 gpm extraction	Operations within or above plan.
2016	1	Hydraulic Control System, Southern Plume South of Barstow-Bakersfield Highway	Operate at monthly target flow rates ²	150 to 400 gpm extraction	60 to 377 gpm extraction	Actual operations were below plan for 7 months in 2016. Total annual average flow rate 20% below plan. The reduced 2016 operations are not estimated to significantly affect remedial timeframes.
2016	1	Northwest Freshwater Injection System	Operate at monthly target flow rates ²	75 gpm injection	72 to 80 gpm injection	Operations within 10% of plan or above.
2016	1	Western Area Extraction	Monthly operation of system ²	ON	ON	Operations within plan.
2016	1	Central Area IRZ	Operate at monthly flow rate and ethanol discharge volume targets ²	75 to 105 gpm recirculation 120 to 405 gallons ethanol	93 to 120 gpm recirculation 260 to 418 gallons ethanol	Operations within or above plan.
2016	1	SCRIA IRZ	Operate at monthly flow rate and ethanol discharge volume targets ²	80 to 110 gpm recirculation 300 to 590 gallons ethanol	85 to 110 gpm recirculation 379 to 621 gallons ethanol.	Operations within or above plan.
2016	1	Source Area IRZ	Operate at monthly flow rate and ethanol discharge volume targets ²	75 to 105 gpm recirculation 700 to 1,000 gallons ethanol	41 to 94 gpm recirculation 408 to 907 gallons ethanol	In September, the ethanol volume was below the minimum allowable volume of 10% below 700 gallons (622 gallons actual; 630 gallons notification minimum). In October and November, actual injection flow rates were 41 and 46 gpm compared to the minimum allowable monthly injection flow rate of 10% below 75 gpm (68 gpm notification minimum), and actual ethanol volumes were 418 and 408 gallons, respectively. Given the short duration of this deviation from the operational plan, these reductions in rates are not anticipated to impact achievement of CAO remedial timeframes, and rates were returned to within 10% of plan or higher by December 2016.
2017	2	Hydraulic Control System, Southern Plume North of Barstow-Bakersfield Highway	Operate at monthly target flow rates ³	530 to 1,100 gpm extraction	601 to 1,177 gpm extraction	Operations within or above plan for 11 months. Below plan in April 2017 by 7 gpm; however, this did not impact system performance, and the system and the average annual flow rate was above plan.
2017	2	Hydraulic Control System, Southern Plume South of Barstow-Bakersfield Highway	Operate at monthly target flow rates ³	70 to 380 gpm extraction	50 to 385 gpm extraction	Operations within or above plan for 9 months, below plan for 3 months (January to March) as expected given the plan for the first 3 months was set before resetting goals based on actual achievable rates. Total annual average flow rate similar to 2016 and not expected to impact remedial timeframes.
2017	2	Northwest Freshwater Injection System	Operate at monthly target flow rates ³	75 gpm injection	77 gpm injection	Operations within or above plan for 11 months. Below plan in March 2017 by 3 gpm; however, this did not impact system performance, and the system and the average annual flow rate was above plan.
2017	2	Western Area Extraction	Monthly operation of system ³	ON	ON	Operations within plan.
2017	2	Central Area IRZ	Operate at monthly flow rate and ethanol discharge volume targets ³	80 to 110 gpm recirculation 200 to 500 gallons ethanol	95 to 115 gpm recirculation 233 to 495 gallons ethanol	Operations within or above plan.
2017	2	SCRIA IRZ	Operate at monthly flow rate and ethanol discharge volume targets ³	80 to 110 gpm recirculation 400 to 1,100 gallons ethanol	57 to 110 gpm recirculation 321 to 1,007 gallons ethanol	In February, the actual injection flow rate was 57 gpm compared to the minimum allowable monthly injection flow rate of 10% below 80 gpm. Given the short duration of this deviation from the operational plan, this reduction in rates is not anticipated to impact achievement of CAO remedial timeframes, and the injection rate was returned to within plan by March 2017.
2017	2	Source Area IRZ	Operate at monthly flow rate and ethanol discharge volume targets ³	70 to 105 recirculation 600 to 1,000 gallons ethanol	57 to 88 gpm recirculation 532 to 891 gallons ethanol	In March, the actual injection flow rate was 64 gpm compared to the monthly goal of 75 gpm. In October, the actual injection flow rate was 57 gpm compared to the monthly goal of 70 gpm, and the actual ethanol volume was below the goal 600 gallons (532 gallons actual). Given the short duration of this deviation from the operational plan, these reductions in rates are not anticipated to impact achievement of CAO remedial timeframes, and rates were returned to within plan in the month following the deviation, April 2016 and November 2016, respectively.
2018	3	Hydraulic Control System, Southern Plume North of Barstow-Bakersfield Highway	Operate at monthly target flow rates ⁴	575 to 1,000 gpm to ATU	599 to 1178 gpm to ATU	Operations above plan in 2018.
2018	3	Hydraulic Control System, Southern Plume South of Barstow-Bakersfield Highway	Operate at monthly target flow rates ⁴	55 to 380 gpm to ATU	90 to 432 gpm to ATU	Operations within or above plan for 11 months. Below plan in March 2018 due to construction within the Community East ATU. This did not impact system performance, and the average annual flow rates for the Southern ATUs were above plan.

Table 2-2
Summary of Key Differences between Planned and Actual Remedy Implementation
Four-Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Calendar Year	Remedy Year	System	Item	Plan	Actual	Notes
2018	3	Northwest Freshwater Injection System	Operate at monthly target flow rates ⁴	75 gpm injection	83 gpm injection	Operations within or above plan for 11 months. Below plan in April 2018 by 1 gpm; however, this did not impact system performance, and the average annual flow rate for the system was above plan.
2018	3	Western Area Extraction	Monthly operation of system ⁴	ON/OFF	ON/OFF	System operated within plan until approval received to cease Western Area extraction.
2018	3	Central Area IRZ	Operate at monthly flow rate and ethanol discharge volume targets ⁴	80 to 110 gpm recirculation 200 to 500 gallons ethanol	90 to 112 gpm recirculation 314 to 523 gallons ethanol	Operations within or above plan.
2018	3	SCRIA IRZ	Operate at monthly flow rate and ethanol discharge volume targets ⁴	80 to 110 gpm recirculation 400 to 1,100 gallons ethanol	89 to 112 gpm recirculation 711 to 1,204 gallons ethanol	Operations within or above plan.
2018	3	Source Area IRZ	Operate at monthly flow rate and ethanol discharge volume targets ⁴	70 to 105 recirculation 350 to 1,000 gallons ethanol	77 to 108 gpm recirculation 639 to1,014 gallons ethanol	Operations within or above plan.
2019	4	Central Area IRZ	Operate at monthly flow rate and ethanol discharge volume targets ⁴	80 to 110 gpm recirculation 200 to 500 gallons ethanol	87 to 120 gpm recirculation 360 to 476 gallons ethanol	Operations within or above plan.
2019	4	SCRIA IRZ	Operate at monthly flow rate and ethanol discharge volume targets ⁴	80 to 110 gpm recirculation 400 to 1,100 gallons ethanol	100 to 140 gpm recirculation 942 to 1,832 gallons ethanol	Operations within or above plan.
2019	4	Source Area IRZ	Operate at monthly flow rate and ethanol discharge volume targets ⁵	70 to 105 recirculation 350 to 1,000 gallons ethanol	81 to 103 gpm recirculation 592 to1,035 gallons ethanol	Operations within or above plan.
2019	4	Hydraulic Control System, Southern Plume North of Barstow-Bakersfield Highway	Operate at monthly target flow rates ⁵	575 to 1,000 gpm to ATU	586 to 1145 gpm to ATU	Operations within or above plan for 10 months. Below plan in March and April 2019 to prevent cr Operations above plan.
2019	4	Hydraulic Control System, Southern Plume South of Barstow-Bakersfield Highway	Operate at monthly target flow rates ⁵	55 to 380 gpm to ATU	140 to 408 gpm to ATU	
2019	4	Northwest Freshwater Injection System	Operate at monthly target flow rates ⁵	75 gpm injection	86 to 88 gpm injection	Operations above plan.
2019	4	Western Area Extraction	Monthly operation of system ⁵	OFF	OFF	Operations within plan.

Notes:

- ¹ Plan per conceptual design and modeling in Remedial Timeframe Assessment (Arcadis 2014).
² 2016 plan per operational targets submitted in the 2015 Annual Cleanup Status and Effectiveness Report (January to December 2015) (Arcadis 2016).
³ 2017 plan per operational targets submitted in the 2016 Annual Cleanup Status and Effectiveness Report (January to December 2016) (Arcadis 2017).
⁴ 2018 plan per operational targets submitted in the 2017 Annual Cleanup Status and Effectiveness Report (January to December 2017) (Arcadis 2018).
⁵ 2019 plan per operational targets submitted in the 2018 Annual Cleanup Status and Effectiveness Report (January to December 2018) (Arcadis 2019).

Acronyms and Abbreviations:

Arcadis = Arcadis U.S., Inc.
CAO = Cleanup and Abatement Order
Cr(VI) = hexavalent chromium
gpm = gallons per minute
HCP = Habitat Conservation Plan
IRZ = In Situ Reactive Zone
ITP = Incidental Take Permit
RTA = Remedial Timeframe Assessment (Arcadis 2014)
SCRIA = South Central Reinjection Area
Water Board = California Regional Water Quality Control Board, Lahontan Region

References:

Arcadis. 2014. Remedial Timeframe Assessment. PG&E Hinkley Compressor Station, Hinkley, California. June 30.
Arcadis. 2016. Annual Cleanup Status and Effectiveness Report (January to December 2015), Hinkley Compressor Station, Hinkley, California. February 26.
Arcadis. 2017. Annual Cleanup Status and Effectiveness Report (January to December 2016), Hinkley Compressor Station, Hinkley, California. February 28.
Arcadis. 2018. Annual Cleanup Status and Effectiveness Report (January to December 2017), Hinkley Compressor Station, Hinkley, California. February 28.
Arcadis. 2019. Annual Cleanup Status and Effectiveness Report (January to December 2018), Hinkley Compressor Station, Hinkley, California. February 28.

Table 2-3
Planned Operations versus Actual Operations, January to December 2019
Four-Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Month ^{1,2}	Central Area IRZ				South Central Reinjection Area IRZ				Source Area IRZ			
	Planned Injection Flow Rate (gpm)	Actual Injection Flow Rate (gpm)	Planned Ethanol Injection Volume (gal)	Actual Ethanol Injection (gal)	Planned Injection Flow Rate (gpm)	Actual Injection Flow Rate (gpm)	Planned Ethanol Injection Volume (gal)	Actual Ethanol Injection (gal)	Planned Injection Flow Rate (gpm)	Actual Injection Flow Rate	Planned Ethanol Injection Volume (gal)	Actual Ethanol Injection Volume (gal)
January 2019	80 to 110	100	200 to 500	411	80 to 110	100	400 to 1,100	1,234	70 to 105	96	350 to 1,000	744
February 2019	80 to 110	120	200 to 500	476	80 to 110	111	400 to 1,100	1,169	70 to 105	99	350 to 1,000	745
March 2019	80 to 110	120	200 to 500	413	80 to 110	107	400 to 1,100	942	70 to 105	99	350 to 1,000	817
April 2019	80 to 110	115	200 to 500	475	80 to 110	107	400 to 1,100	1,231	70 to 105	103	350 to 1,000	750
May 2019	80 to 110	101	200 to 500	421	80 to 110	140	400 to 1,100	1,506	70 to 105	99	350 to 1,000	1,006
June 2019	80 to 110	98	200 to 500	421	80 to 110	127	400 to 1,100	1,506	70 to 105	81	350 to 1,000	592
July 2019	80 to 110	101	200 to 500	406	80 to 110	137	400 to 1,100	1,547	70 to 105	89	350 to 1,000	802
August 2019	80 to 110	90	200 to 500	452	80 to 110	137	400 to 1,100	1,832	70 to 105	89	350 to 1,000	852
September 2019	80 to 110	88	200 to 500	399	80 to 110	135	400 to 1,100	1,351	70 to 105	86	350 to 1,000	715
October 2019	80 to 110	97	200 to 500	416	80 to 110	136	400 to 1,100	1,587	70 to 105	87	350 to 1,000	879
November 2019	80 to 110	89	200 to 500	360	80 to 110	117	400 to 1,100	1,314	70 to 105	86	350 to 1,000	745
December 2019	80 to 110	87	200 to 500	435	80 to 110	131	400 to 1,100	1,767	70 to 105	87	350 to 1,000	1,035

Month ^{1,2}	Northern ATU		Southern ATU		NWF1		Western Area Extraction	
	Planned Flow Rate of Extracted Water Applied to Fields (gpm)	Actual Flow Rate of Extracted Water Applied to Fields (gpm)	Planned Flow Rate of Extracted Water Applied to Fields (gpm)	Actual Flow Rate of Extracted Water Applied to Fields (gpm)	Planned Injection Flow Rate (gpm)	Actual Injection Flow Rate (gpm)	Planned Operational Status	Actual Operational Status
January 2019	575	586	55 to 85	140	75	87	OFF ³	OFF
February 2019	575	613	55 to 85	152	75	86	OFF	OFF
March 2019	700	659	150 to 200	209	75	86	OFF	OFF
April 2019	800	778	150 to 200	350	75	86	OFF	OFF
May 2019	900	1,009	260 to 300	347	75	87	OFF	OFF
June 2019	1,000	1,056	330 to 380	404	75	87	OFF	OFF
July 2019	1,000	1,077	330 to 380	375	75	86	OFF	OFF
August 2019	1,000	1,145	300 to 350	408	75	88	OFF	OFF
September 2019	950	1,072	270 to 300	386	75	88	OFF	OFF
October 2019	575	630	185 to 210	311	75	88	OFF	OFF
November 2019	575	595	85 to 100	188	75	88	OFF	OFF
December 2019	575	615	85 to 100	154	75	86	OFF	OFF

Table 2-3
Planned Operations versus Actual Operations, January to December 2019
Four-Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Notes:

- ¹ Operational plan rates and volumes for January through March 2018 were proposed in the Annual Cleanup Status and Effectiveness Report (January to December 2017) (Arcadis 2018). Operational plan rates and volumes for April through December 2019 were proposed in the Annual Cleanup Status and Effectiveness Report (January to December 2018) (Arcadis 2019).
- ² IRZ operational plan ranges were based on 2018 injection flow rates and injected ethanol volumes.
- ³ On September 26, 2017, PG&E submitted a request to modify components of the Western Action Plan (Arcadis 2017), which included a request to operate the Northwest Area extraction wells (including EX-36) as needed in the future, rather than continuously as is currently required, as new extraction well EX-53 is more optimally located for chromium mass removal while maintaining inward hydraulic gradients. The Water Board accepted PG&E's September 26, 2017 request in a letter titled, "Acceptance of Modifications to Action Plan for the Western Plume Area, Pacific Gas and Electric Company Hinkley Compressor Station, San Bernardino County (Cleanup and Abatement Order R6V-2015-0068) (Water Board 2018). Therefore, extractions at EX-36 were suspended on July 25, 2018.

Acronyms and Abbreviations:

gal = gallons
gpm = gallons per minute
IRZ = In Situ Reactive Zone
ATU = Agricultural Treatment Unit
NWFI = Northwest Freshwater Injection

References:

Arcadis. 2017. Proposed Modifications to the Action Plan for the Western Area, Pacific Gas and Electric Company (PG&E), Hinkley Compressor Station, Hinkley, California. September 26.

Arcadis. 2018. Annual Cleanup Status and Effectiveness Report (January to December 2017), Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California. February 28.

Arcadis. 2019. Annual Cleanup Status and Effectiveness Report (January to December 2018), Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California. February 28.

Water Board. 2018. Acceptance of Modifications to Action Plan for the Western Plume Area, Pacific Gas and Electric Company Hinkley Compressor Station, San Bernardino County (Cleanup and Abatement Order R6V-2015-0068). July 25.

Table 2-4
Remedial System Operational Plan, April 2020 through March 2021
Four-Year and Annual Cleanup Status and Effectiveness Report (2016 to 2019)
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Month	Total IRZ ¹		Northern ATUs ²	Southern ATUs ²	NWFI	Western Area Extraction
	Injection Flow Rate (gpm)	Ethanol Injection ³ (gal)	Flow Rate of Extracted Water Applied to Fields (gpm)	Flow Rate of Extracted Water Applied to Fields (gpm)	Injection Flow Rate	Operational Status
April 2020	300 to 350	940 to 3,670	725	150 to 200	75	OFF
May 2020	300 to 350	940 to 3,670	900	260 to 300	75	OFF
June 2020	300 to 350	940 to 3,670	1,000	330 to 380	75	OFF
July 2020	300 to 350	940 to 3,670	1,000	330 to 380	75	OFF
August 2020	300 to 350	940 to 3,670	1,000	300 to 350	75	OFF
September 2020	300 to 350	940 to 3,670	950	270 to 300	75	OFF
October 2020	300 to 350	940 to 3,670	575	185 to 210	75	OFF
November 2020	300 to 350	940 to 3,670	575	85 to 100	75	OFF
December 2020	300 to 350	940 to 3,670	575	85 to 100	75	OFF
January 2021	300 to 350	940 to 3,670	575	85 to 100	75	OFF
February 2021	300 to 350	940 to 3,670	575	85 to 100	75	OFF
March 2021	300 to 350	940 to 3,670	625	150 to 200	75	OFF

Notes:

¹ IRZ operational plan ranges are based on 2019 injection flow rates and injected ethanol volumes and projected flow rates for new injection wells. The IRZ operational plan includes all IRZ systems including Central Area, South-Central Reinjection Area, Source Area, and Western Community Boulevard.

² ATU operational plan ranges are based on seasonal pumping plans. Ranges have been provided for the Southern ATUs to account for possible changes in farming and routine downtime associated with farming activities such as harvesting, replanting, and plowing.

³ Broad range of ethanol injection volumes to allow decrease or increase in total organic carbon dosing concentrations.

Acronyms and Abbreviations:

ATU = Agricultural Treatment Unit

gal = gallons

gpm = gallons per minute

IRZ = In Situ Reactive Zone

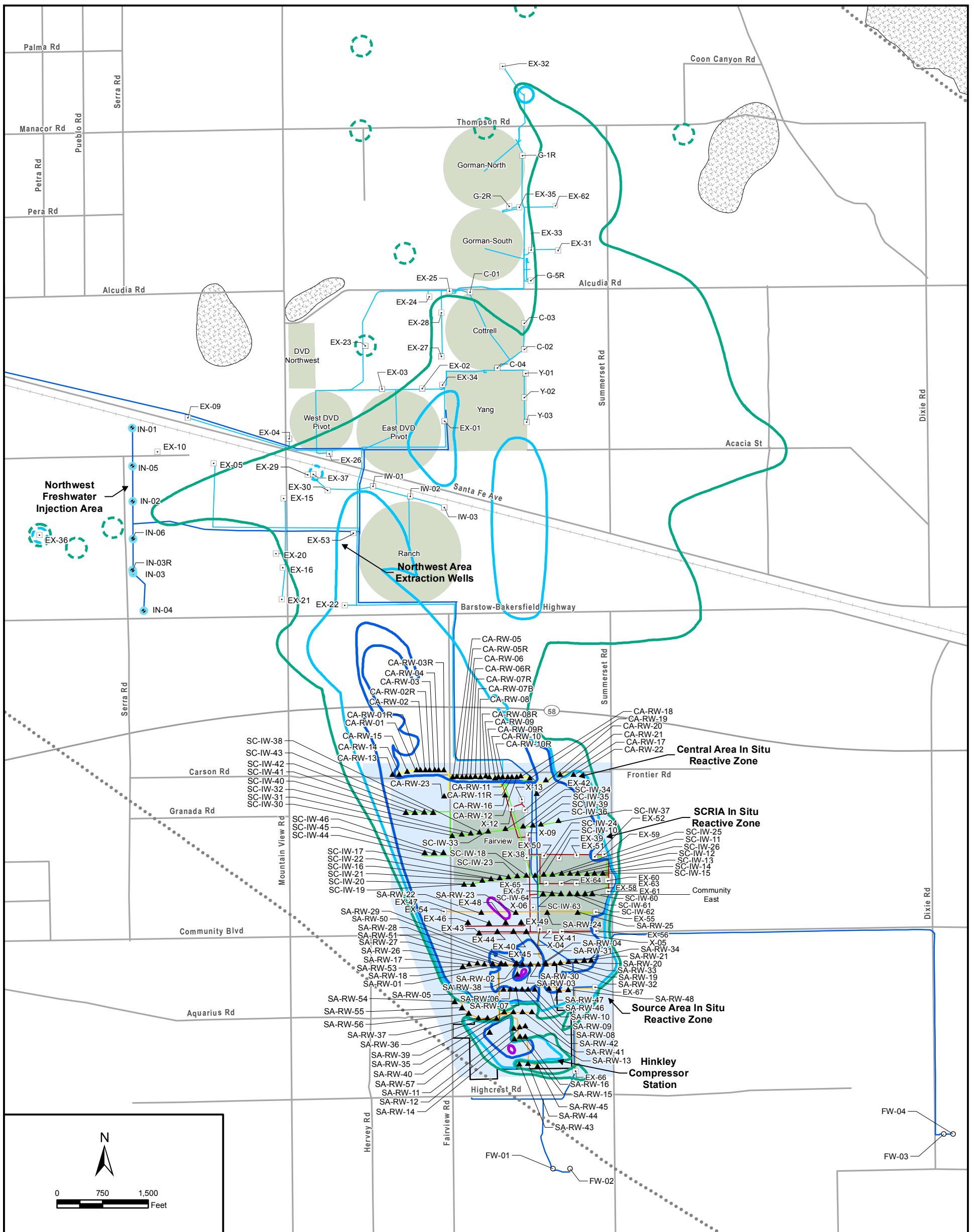
NWFI = Northwest Freshwater Injection

FIGURES














FIGURES





LEGEND:

-  Freshwater Injection Well
-  Groundwater Extraction Well
-  IRZ Remediation Well
-  Freshwater Supply Well
-  Approximate Location of Fault Trace is Inferred and There is No Surface Expression (Stamos et al. 2001)
-  Central Area Piping
-  Fresh Water Injection Piping
-  Source Area Piping
-  SCRIA Piping
-  Southern ATU Piping
-  Northern ATU Piping

Chromium Plume Fourth Quarter 2019


Environmental Plume Fourth Quarter 2019


Approximate Outline of Cr(VI) or Cr(T) in the Upper Aquifer Exceeding Values of 3.1 and 3.2 µg/L, Respectively, Fourth Quarter 2019 (Dashed Where Inferred)


Approximate 10 µg/L Outline of Cr(VI) or Cr(T) Concentrations in Upper Aquifer, Fourth Quarter 2019 (Dashed Where Inferred)

Approximate 50 µg/L Outline of Cr(VI) or Cr(T) Concentrations in Upper Aquifer, Fourth Quarter 2019

Approximate 1000 µg/L Outline of Cr(VI) or Cr(T) Concentrations in the Upper Aquifer, Fourth Quarter 2019

 Bedrock Exposed at Ground Surface

 Active Agricultural Treatment Unit

 IRZ

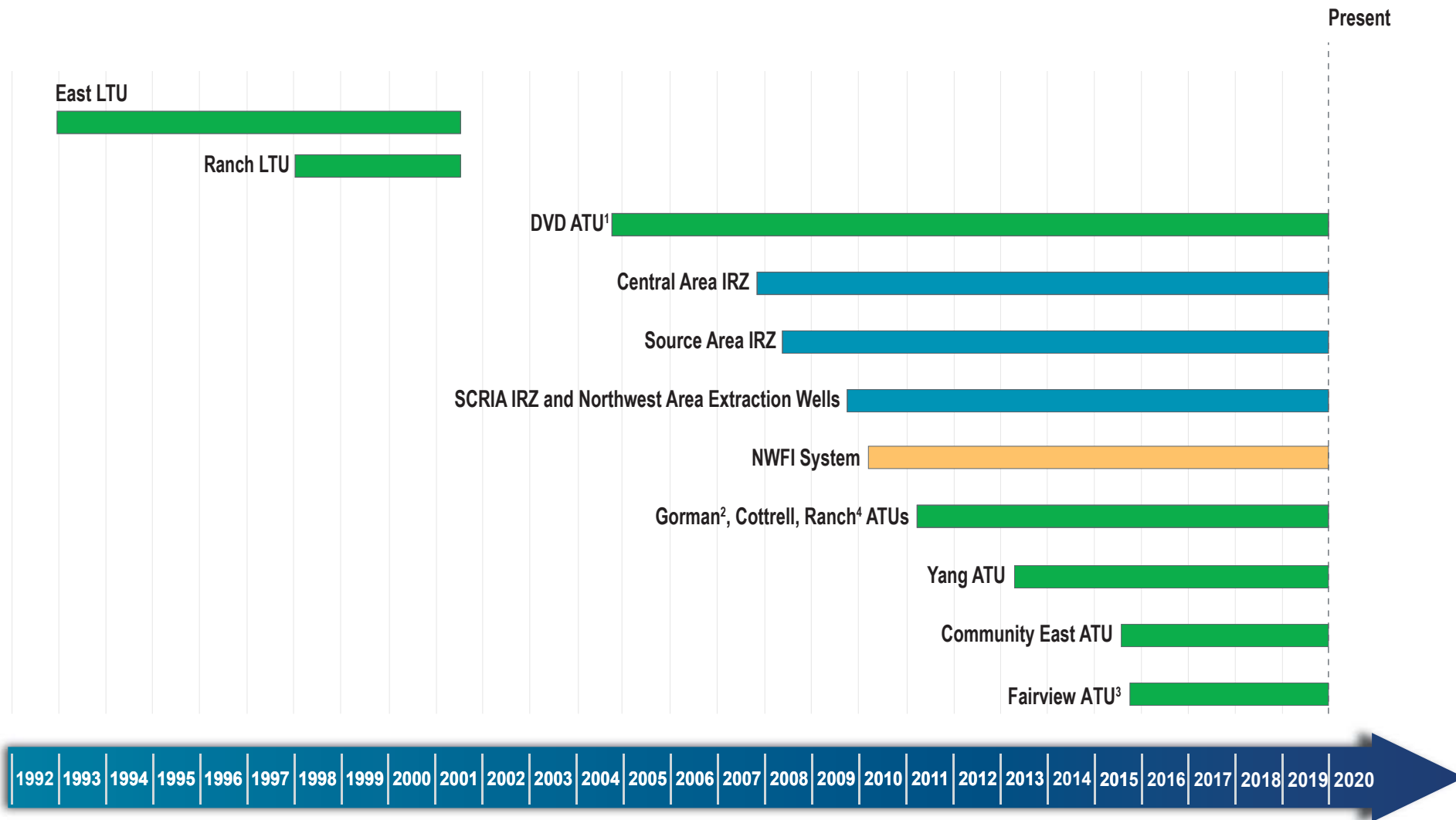
WORK CITED:

Stamos, C.L., P. Martin, T. Nishikaw, and B.F. Cox. 2001. *Simulation of Ground-Water Flow in the Mojave River Basin, California*. U. S. Geological Survey Water-Resources Investigations Report 01-4002, Version 3. Prepared in cooperation with the Mojave Water Agency.

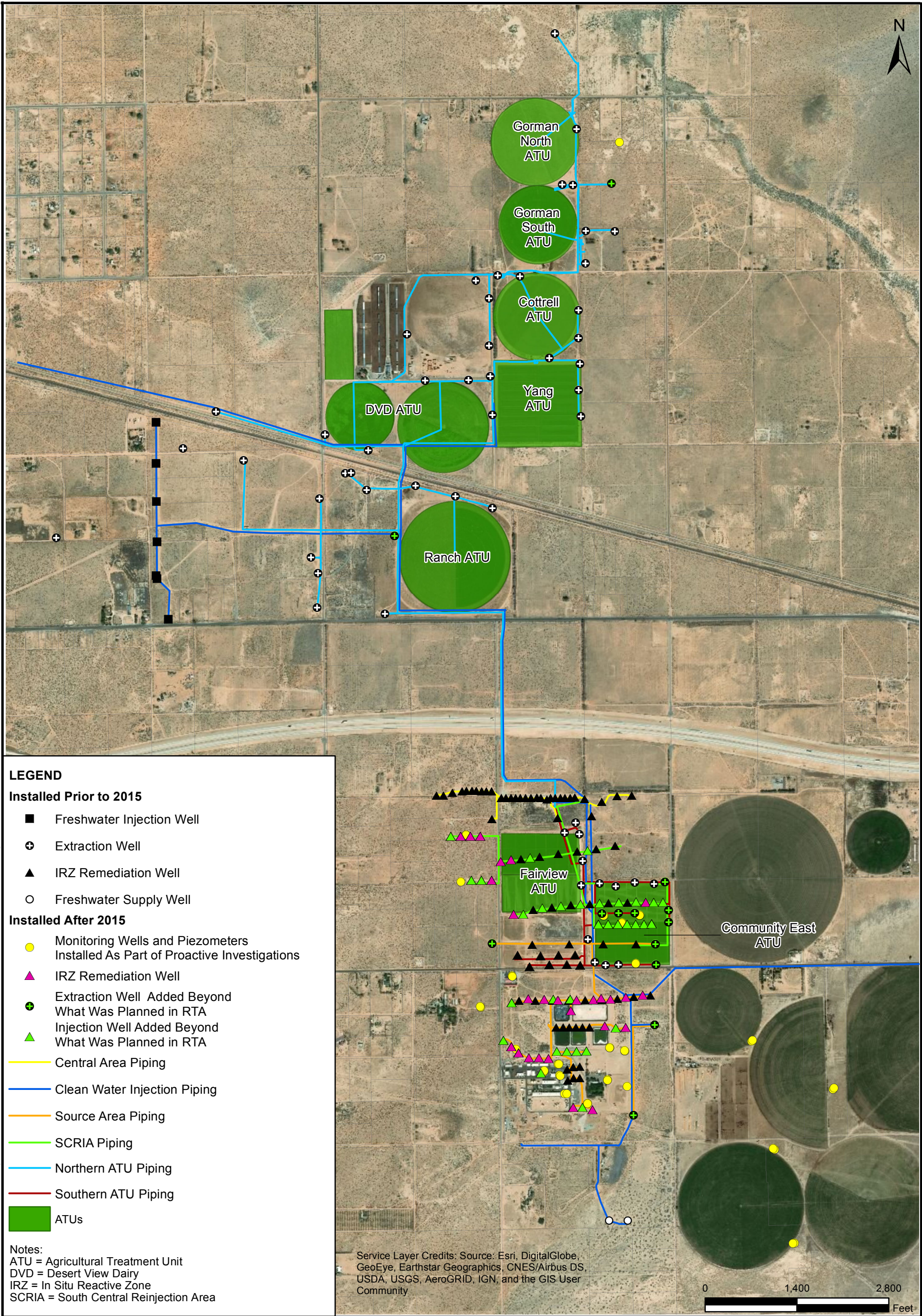
NOTES:


ATU = Agricultural Treatment Unit
DVD = Desert View Dairy
IRZ = In Situ Reactive Zone
SCRIA = South Central Reinjection Area
µg/L = microgram per liter
Cr(T) = total dissolved chromium
Cr(VI) = hexavalent chromium

FIGURE 2-1
LAYOUT OF REMEDIAL SYSTEMS
FOUR-YEAR COMPREHENSIVE CLEANUP STATUS
AND EFFECTIVENESS REPORT (2016 TO 2019)
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA

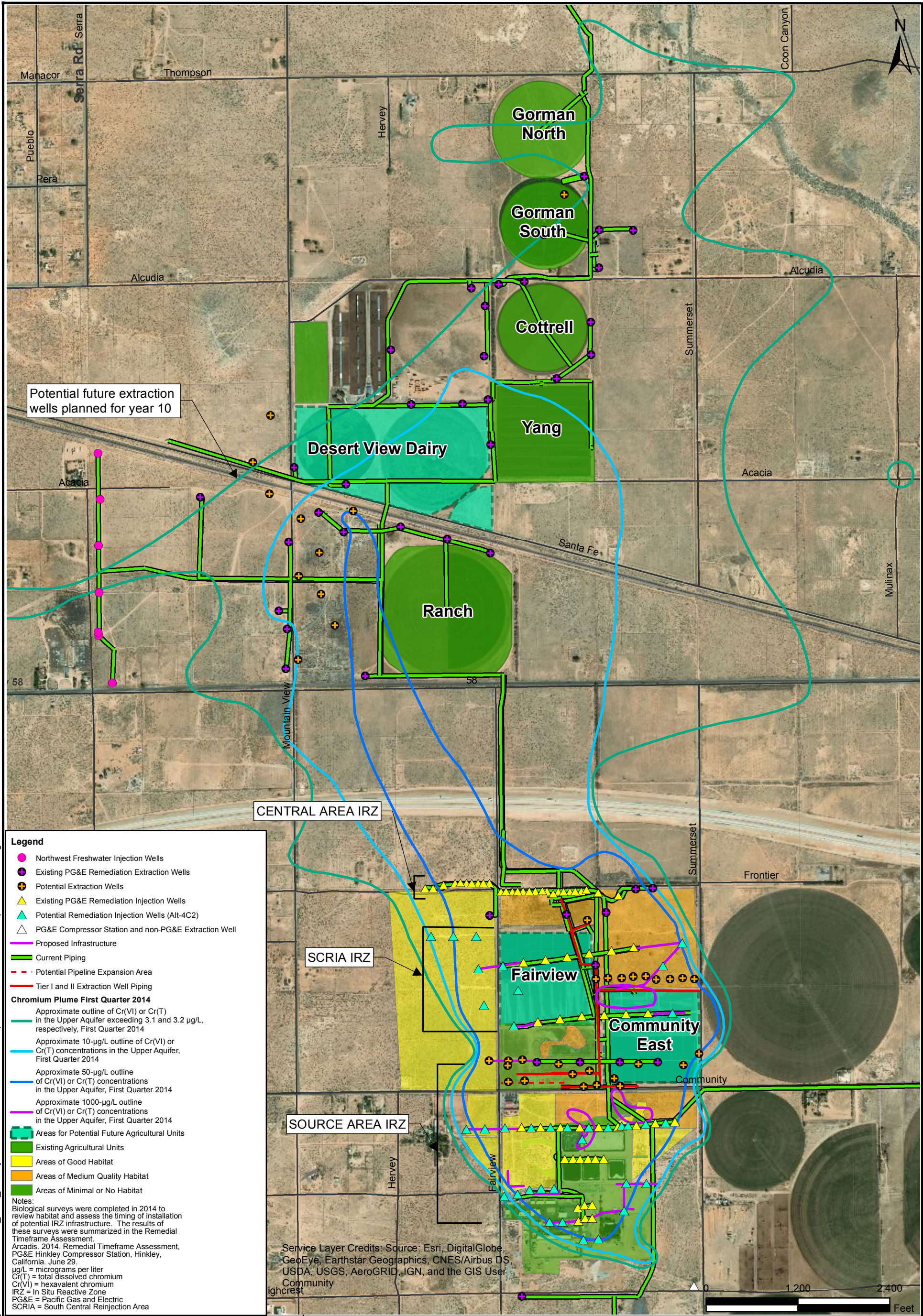


Drafter: BCG Path: Z:\GIS\Projects\ENVR\000699.0001_PGE_Hinkley\GIS\GEC\MXD\Annual Cleanup Status & Effectiveness Rpt\2019\Final\Fig2-3_Remedial Construction Since 2019.mxd Date: 3/11/2020 Time: 2:12:26 AM



Program Manager Jenifer Beatty	 100 Montgomery Street, Suite 300 San Francisco, California 94104 Tel: 415 374 2744 Fax: 415 374 2745 www.arcadis-us.com	REMEDIAL CONSTRUCTION TO DATE Four-Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019) Pacific Gas and Electric Company Hinkley Compressor Station Hinkley, California	Project Number RC000699.0148
			Date 3/11/2020
			Figure 2-3

Drafter: BCG Path: Z:\GIS\Projects\ENVR\000699.0001_PGE_Hinkley\GIS\GEC\MXD\Annual Cleanup Status & Effectiveness Rpt\2019\Final\Fig2-4 RemedialInfrastructurePlanned.mxd Date: 3/11/2020 Time: 6:24:46 AM



100 Montgomery Street, Suite 300
San Francisco, California 94104
Tel: 415 374 2744
Fax: 415 374 2745
www.arcadis-us.com

Remedial Infrastructure Planned in the Remedial Timeframe Assessment

Four-Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)

Pacific Gas and Electric Company
Hinkley, California

Project Number
RC000699.0099

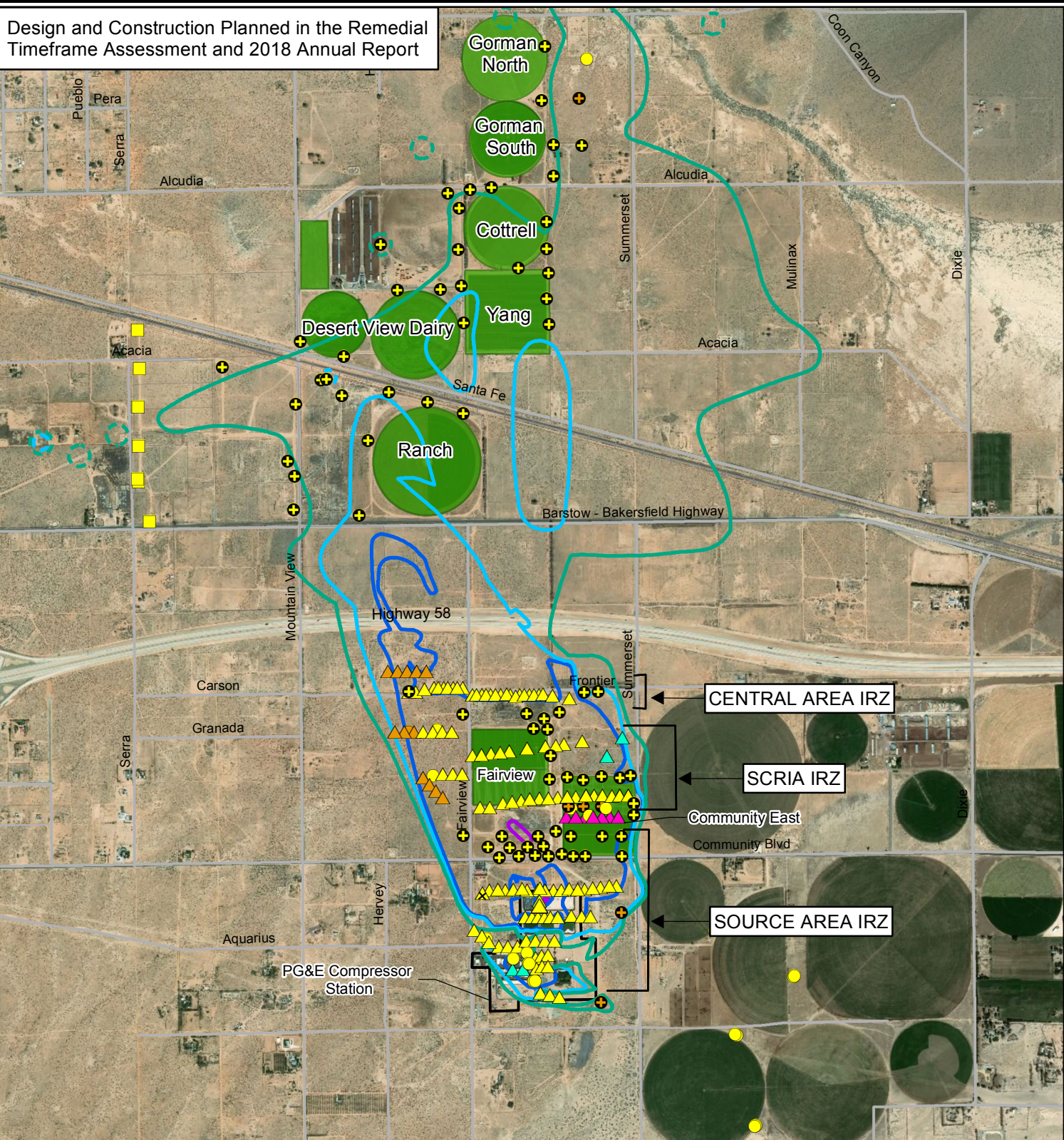
Date
3/11/2020

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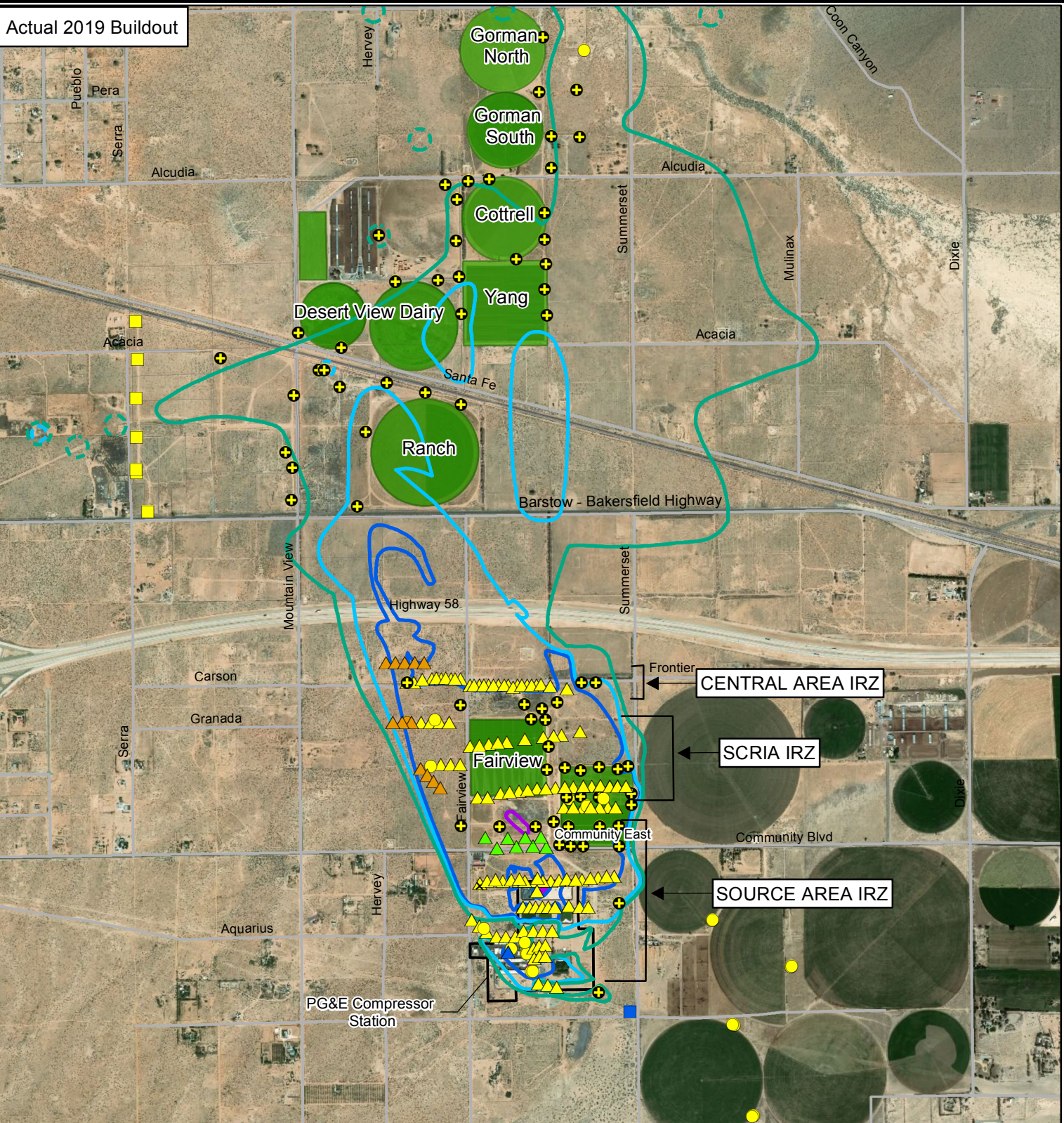
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Design and Construction Planned in the Remedial Timeframe Assessment and 2018 Annual Report



Actual 2019 Buildout



Legend

- Northwest Freshwater Injection Wells
- Freshwater pilot injection well connected in 2019
- Monitoring Well and Piezometer
- Monitoring Well Planned in 2019, Not Installed, Anticipated Installation in 2020
- Existing PG&E Remediation Extraction Wells
- New Extraction Well Installed in 2018 and Operated in 2019
- Existing PG&E Remediation Injection Wells
- Potential Remediation Injection Wells (Alt-4C2)
- New IRZ Remediation Well Installed in 2018 and Operated in 2019
- Existing Extraction Well Conversion to IRZ Injection Well Designed in 2019, Operation Planned in 2020
- IRZ Remediation Well Planned in 2019, Not Installed, Anticipated Installation in 2020
- IRZ Remediation Well Installed in 2019 and Operated in 2020
- Chromium Plume Fourth Quarter 2019
- Approximate Outline of Cr(VI) or Cr(T) in the Upper Aquifer Exceeding Values of 3.1 and 3.2 µg/L, Respectively, Fourth Quarter 2019 (Dashed Where Inferred)
- Approximate 10 µg/L Outline of Cr(VI) or Cr(T) Concentrations in Upper Aquifer, Fourth Quarter 2019 (Dashed Where Inferred)
- Approximate 50 µg/L Outline of Cr(VI) or Cr(T) Concentrations in Upper Aquifer, Fourth Quarter 2019
- Approximate 1000 µg/L Outline of Cr(VI) or Cr(T) Concentrations in the Upper Aquifer, Fourth Quarter 2019
- Existing Agricultural Treatment Units

Notes:
µg/L = micrograms per liter
Cr(T) = total dissolved chromium
Cr(VI) = hexavalent chromium
IRZ = In Situ Reactive Zone
PG&E = Pacific Gas and Electric
SCRIA = South Central Reinjection Area

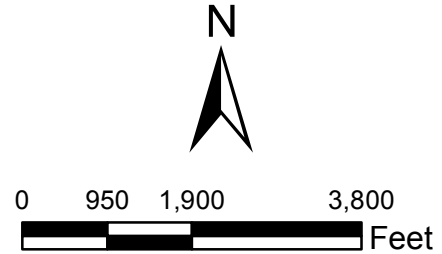
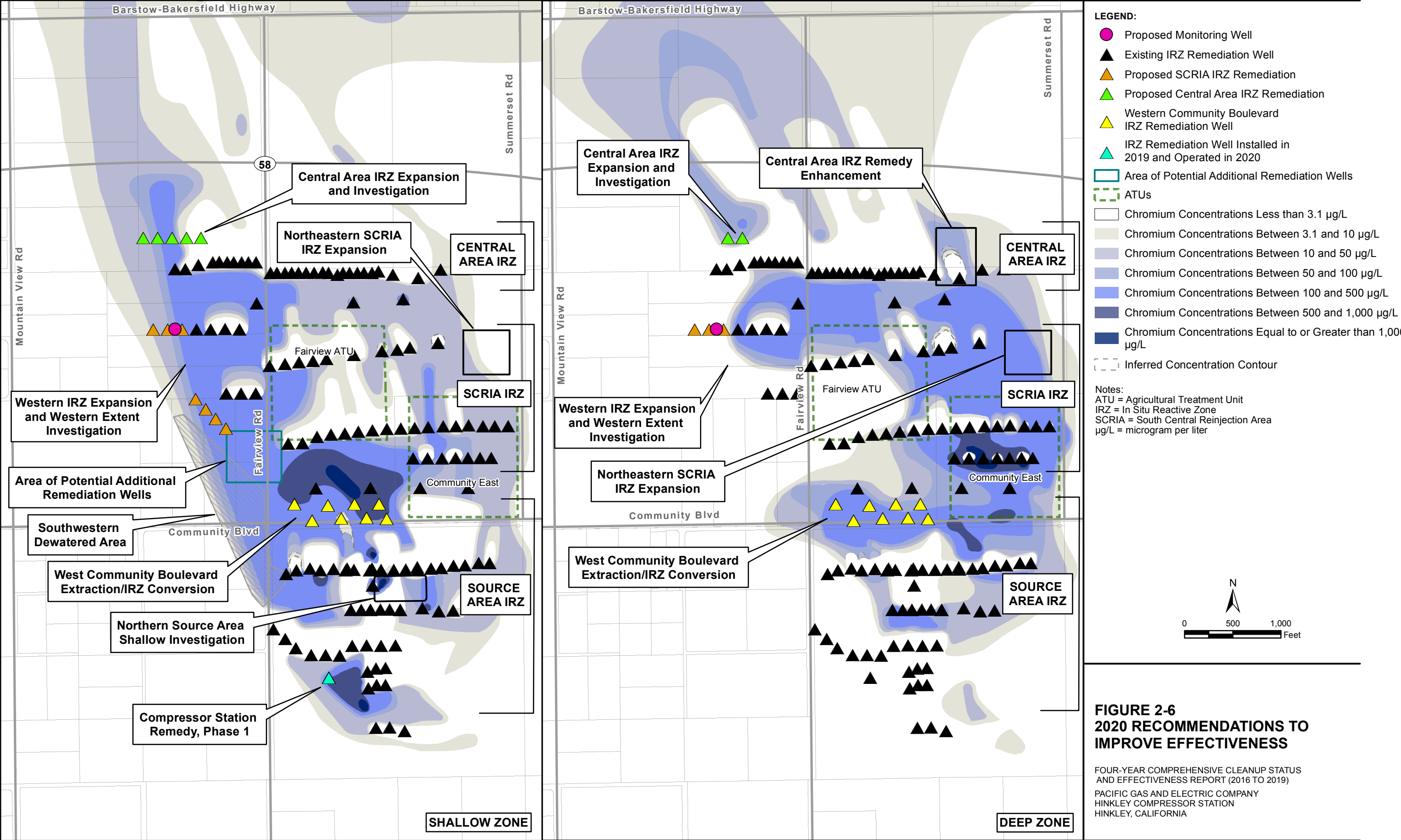
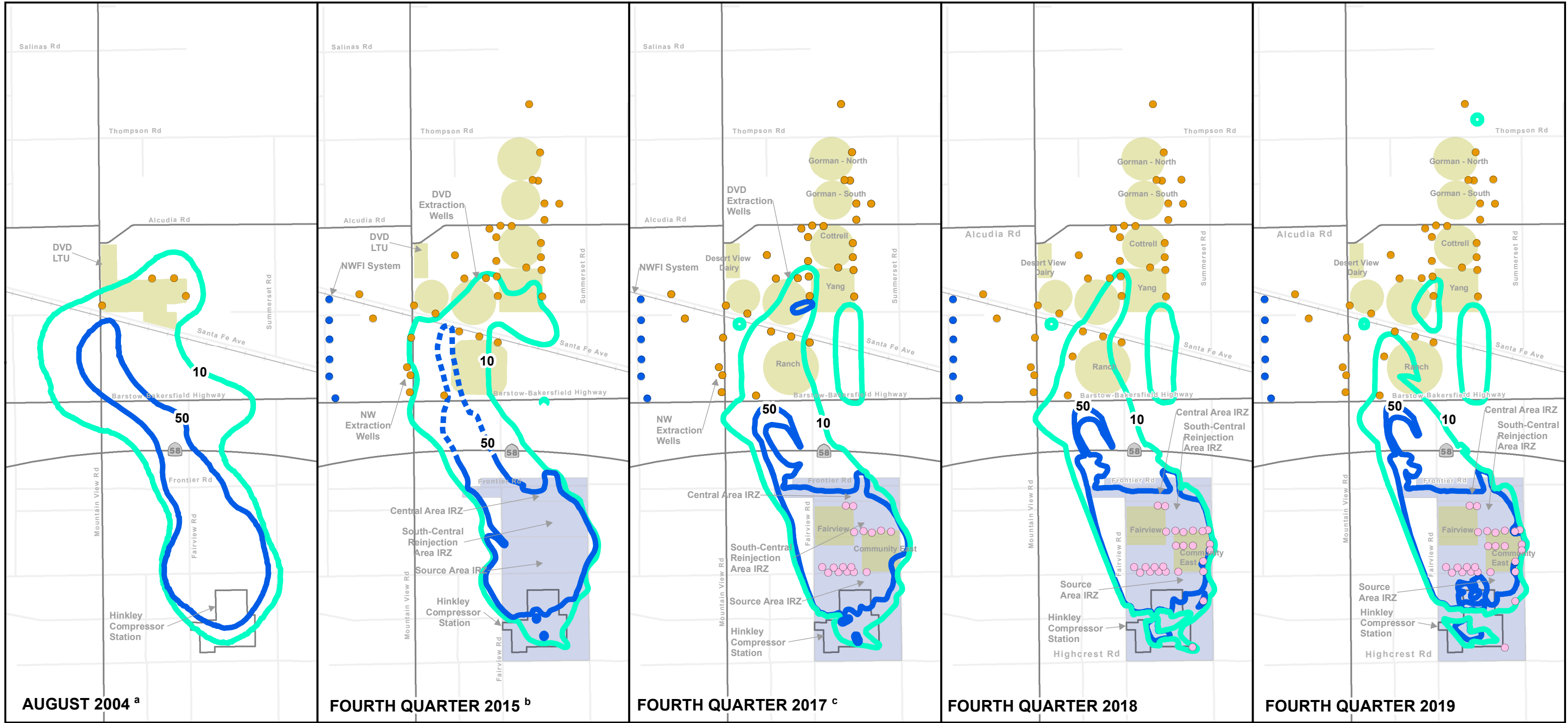


FIGURE 2-5
DESIGN AND CONSTRUCTION PLANNED IN THE
REMEDIAL TIMEFRAME ASSESSMENT AND 2018
ANNUAL REPORT VS. ACTUAL 2019 BUILDOUT

FOUR-YEAR COMPREHENSIVE CLEANUP STATUS
AND EFFECTIVENESS REPORT (2016 TO 2019)
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY, CALIFORNIA







- Legend**
- NWFI Wells
 - Northern ATU and Northwest Extraction Wells
 - Southern ATU Extraction Wells
 - Approximate 10 µg/L Outline of Cr(VI) or Cr(T) Concentrations in Upper Aquifer
 - Approximate 50 µg/L Outline of Cr(VI) or Cr(T) Concentrations in Upper Aquifer
 - Agricultural Water Treatment

Notes:
 µg/L = micrograms per liter
 Cr(VI) = hexavalent chromium
 Cr(T) = total dissolved chromium
 ATU = Agricultural Treatment Unit
 DVD LTU = Desert View Dairy Land Treatment Unit
 IRZ = In situ Reactive Zone
 NWFI = Northwest Freshwater Injection System

^a DVD LTU began operating in September 2004.
^b ATU operations for Gorman ATU began March 2011; Cottrell ATU and Ranch ATU began May/June 2011; and Yang ATU began April 2013 when CommE Fairview ATU EAST LTU started?
^c Community East ATU and South of Fairview ATUs began operating in 2015 when Community East ATU and Fairview ATU started.

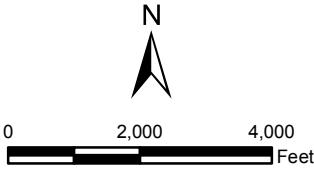
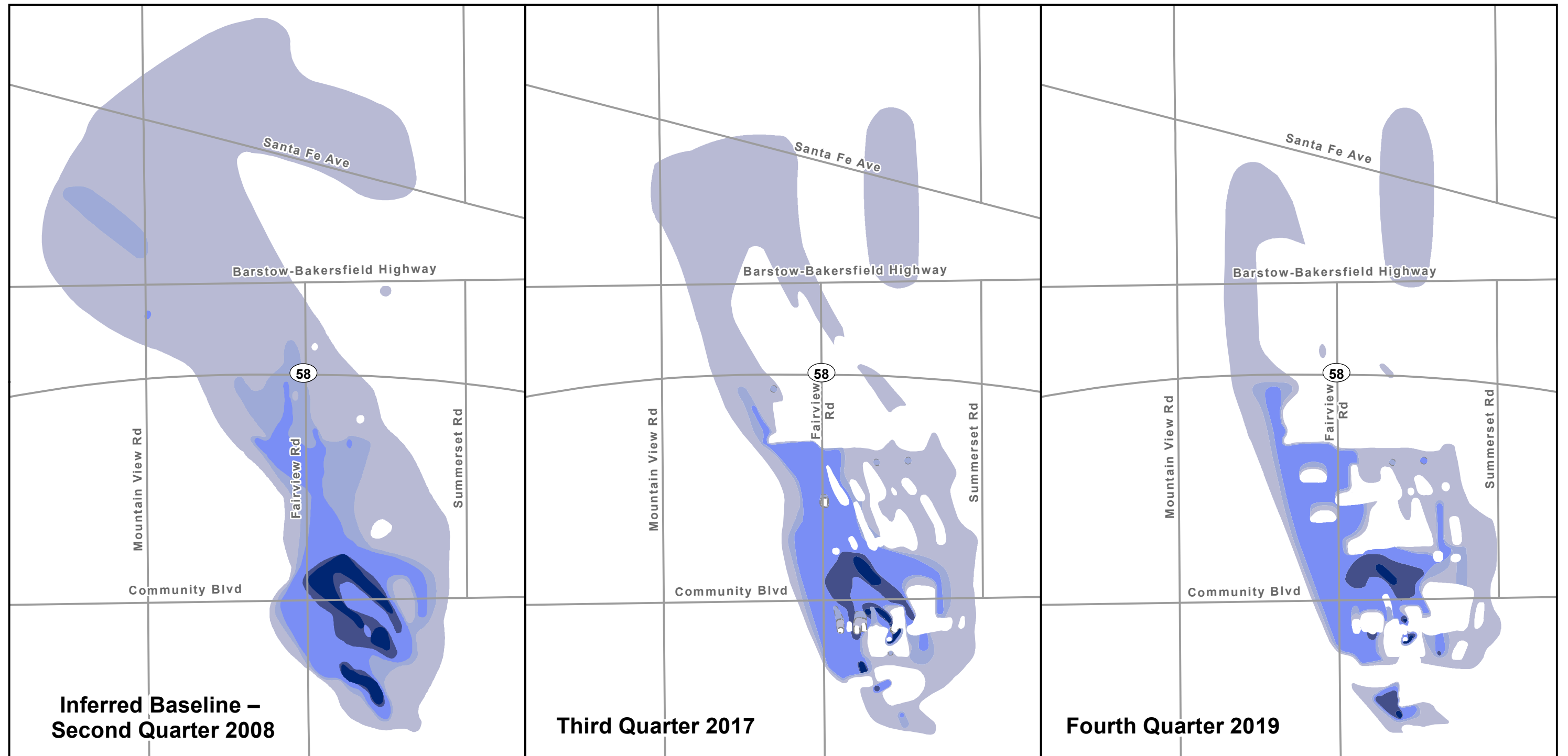


FIGURE 3-1
CHANGES IN CHROMIUM MAXIMUM
ISOCONCENTRATION CONTOURS FROM
AUGUST 2004 THROUGH DECEMBER 2019

FOUR-YEAR COMPREHENSIVE CLEANUP STATUS AND
EFFECTIVENESS REPORT (2016 TO 2019)

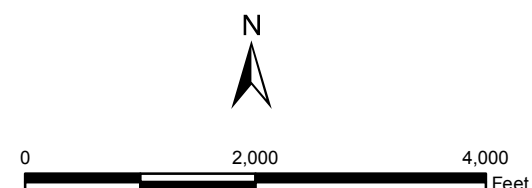
PACIFIC GAS AND ELECTRIC COMPANY
 HINKLEY COMPRESSOR STATION
 HINKLEY, CALIFORNIA



Legend

- Chromium Concentrations Between 10 and 50 µg/L
- Chromium Concentrations Between 50 and 100 µg/L
- Chromium Concentrations Between 100 and 500 µg/L
- Chromium Concentrations Between 500 and 1,000 µg/L
- Chromium Concentrations Equal to or Greater than 1,000 µg/L

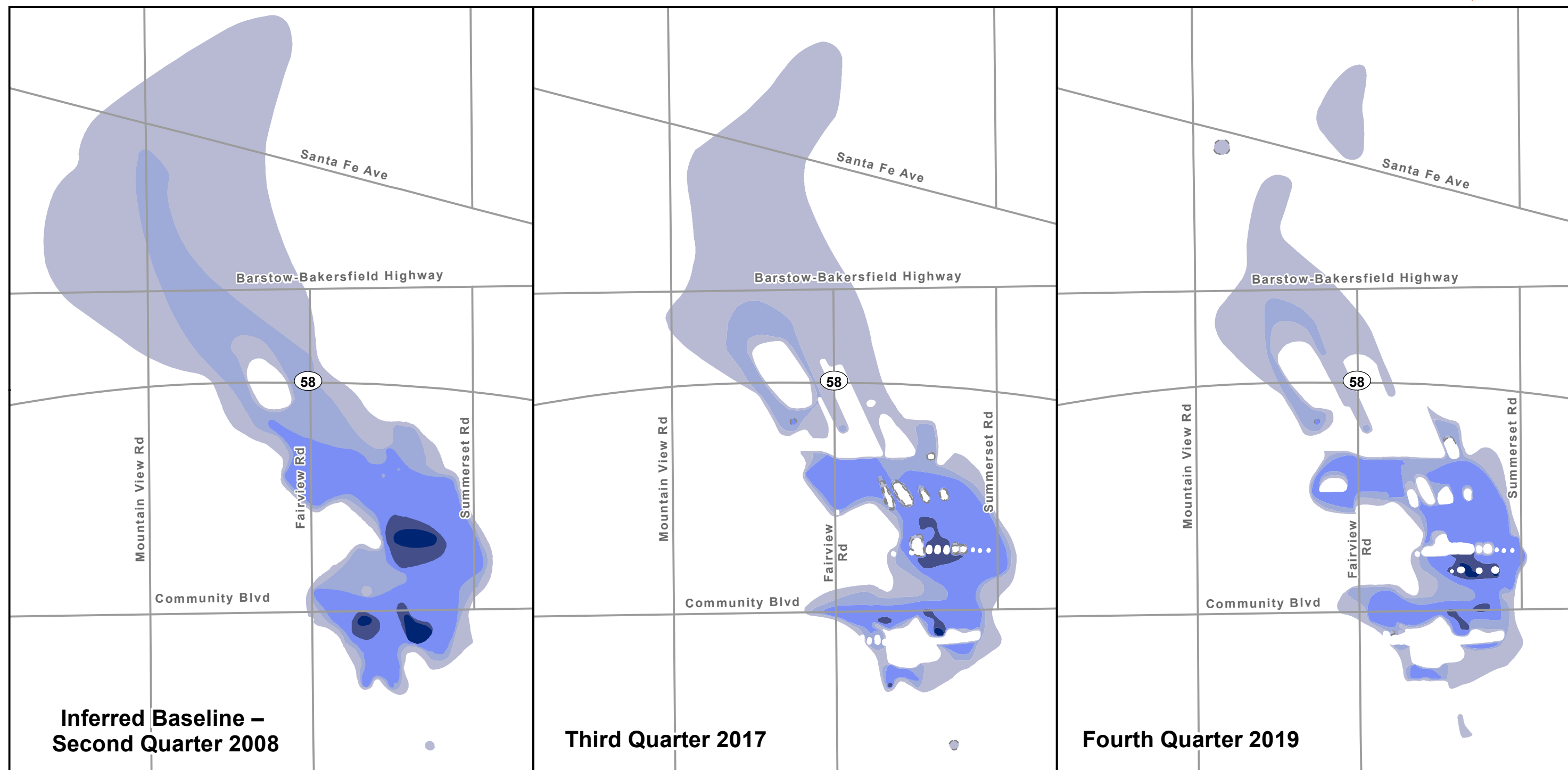
Note:
µg/L - micrograms per liter.



**FIGURE 3-2
IRZ AREA TOTAL DISSOLVED CHROMIUM AND
HEXAVALENT CHROMIUM CONCENTRATIONS
(SHALLOW ZONE OF THE UPPER AQUIFER)**

FOUR-YEAR COMPREHENSIVE CLEANUP STATUS AND
EFFECTIVENESS REPORT (2016 TO 2019)

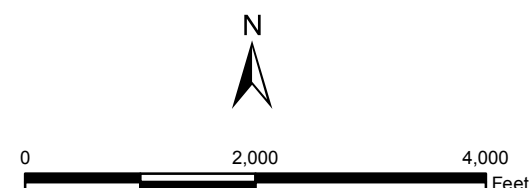
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA



Legend

- Chromium Concentrations Between 10 and 50 µg/L
- Chromium Concentrations Between 50 and 100 µg/L
- Chromium Concentrations Between 100 and 500 µg/L
- Chromium Concentrations Between 500 and 1,000 µg/L
- Chromium Concentrations Equal to or Greater than 1,000 µg/L

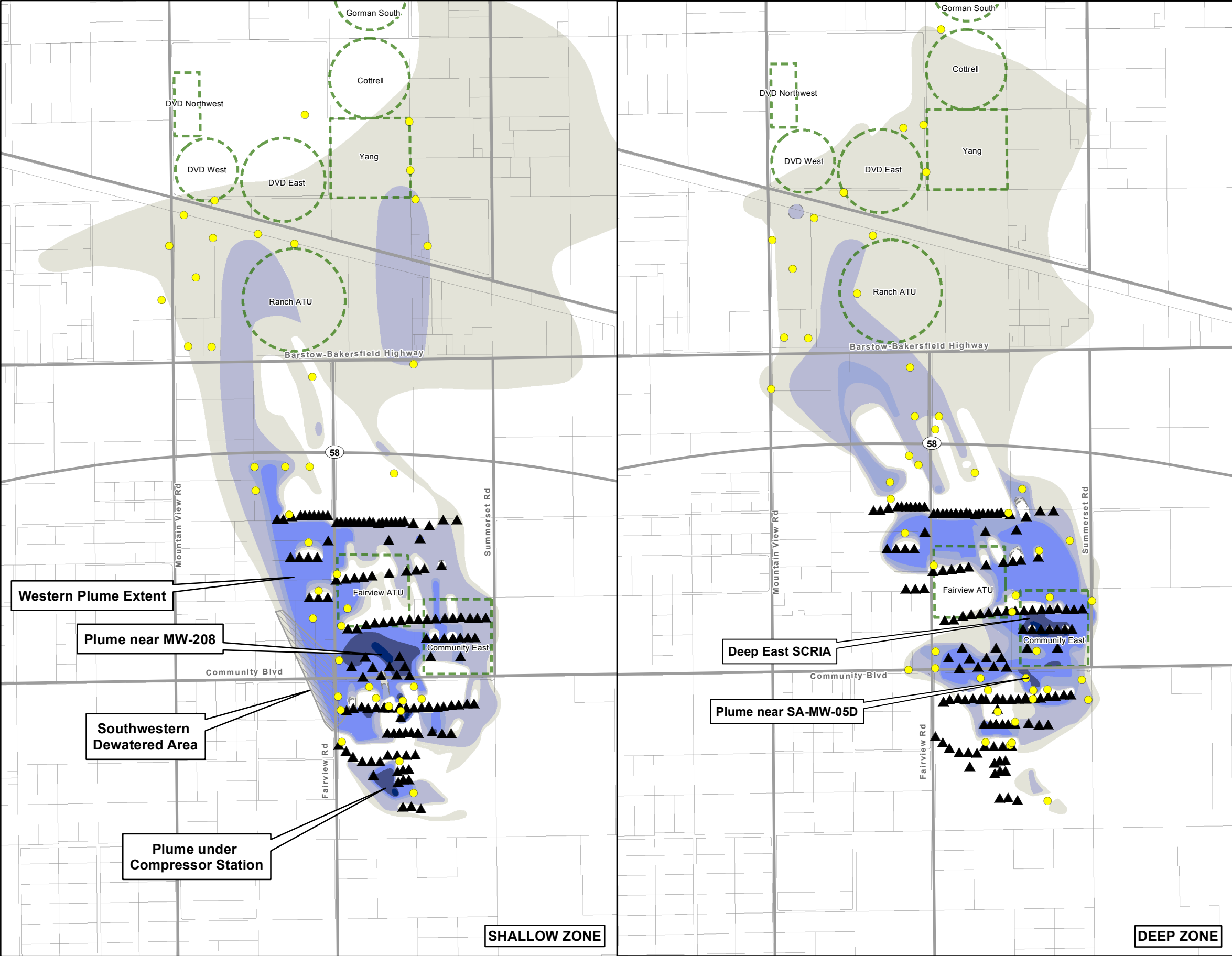
Note:
µg/L - micrograms per liter.



**FIGURE 3-3
IRZ AREA TOTAL DISSOLVED CHROMIUM AND
HEXAVALENT CHROMIUM CONCENTRATIONS
(DEEP ZONE OF THE UPPER AQUIFER)**

FOUR-YEAR COMPREHENSIVE CLEANUP STATUS AND
EFFECTIVENESS REPORT (2016 TO 2019)

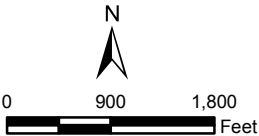
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA



LEGEND:

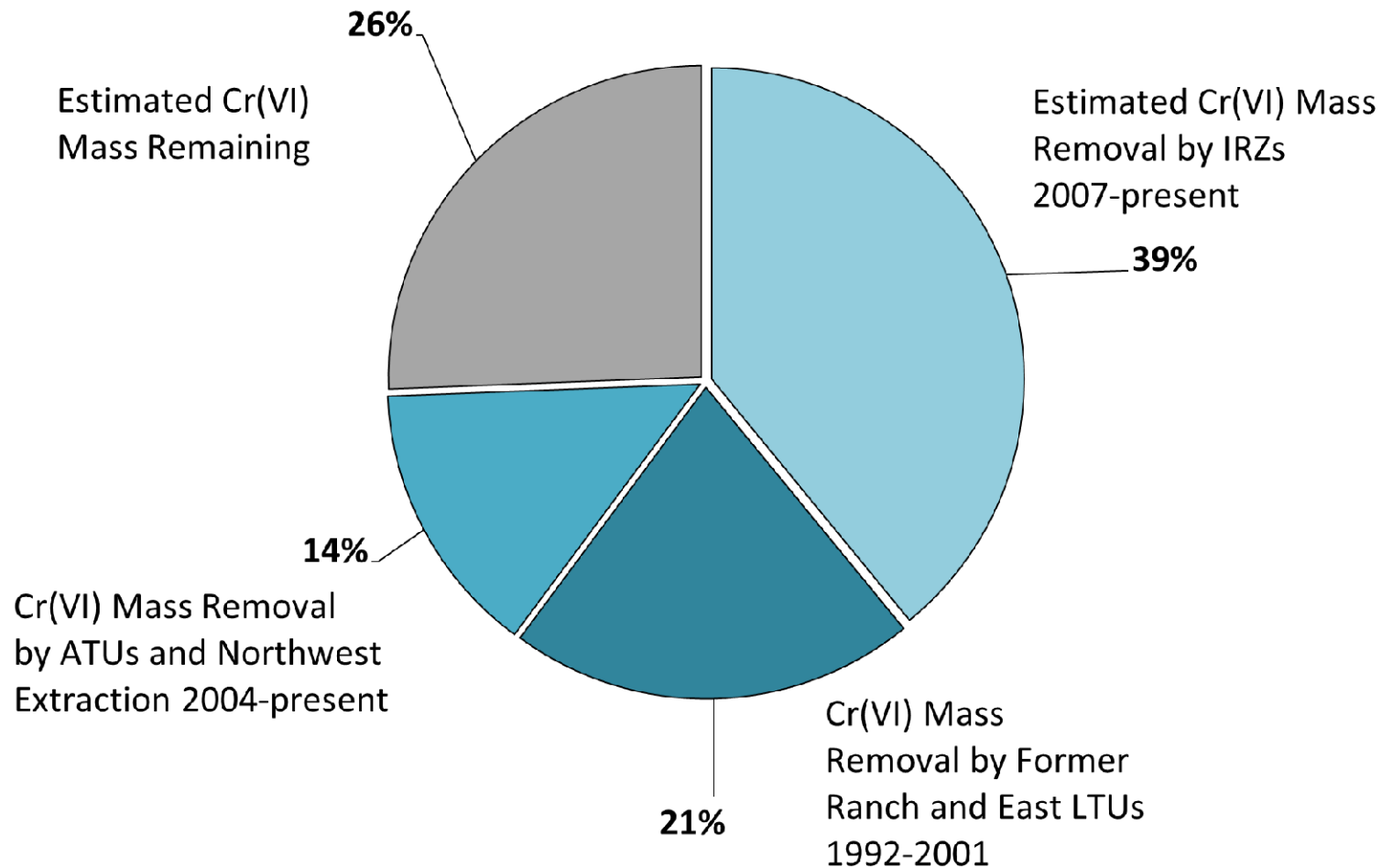
- CAO Monitoring Wells
- ▲ IRZ Remediation Well
- ATUs
- Chromium Concentrations Less than 3.1 µg/L
- Chromium Concentrations Between 3.1 and 10 µg/L
- Chromium Concentrations Between 10 and 50 µg/L
- Chromium Concentrations Between 50 and 100 µg/L
- Chromium Concentrations Between 100 and 500 µg/L
- Chromium Concentrations Between 500 and 1,000 µg/L
- Chromium Concentrations Equal to or Greater than 1,000 µg/L
- - - Inferred Concentration Contour

Notes:
ATU = Agricultural Treatment Unit
DVD = Desert View Dairy
IRZ = In Situ Reactive Zone
SCRIA = South Central Reinjection Area
CAO = Cleanup and Abatement Order
µg/L = microgram per liter



**FIGURE 3-4
KEY AREAS OF INTEREST**

FOUR-YEAR COMPREHENSIVE CLEANUP STATUS
AND EFFECTIVENESS REPORT (2016 TO 2019)
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA



Notes:

1. The mass of chromium removed by IRZ treatment was calculated as the difference in the estimate of Cr(VI) mass present in groundwater south of Highway 58 before full-scale IRZ operation (baseline) and the estimate of Cr(VI) mass present in groundwater at subsequent time steps (i.e., Fourth Quarter of 2018, Fourth Quarter of 2019) and was corrected for Cr(VI) removed by the southern ATUs, as documented in Appendix B. A similar calculation was made for the mass of chromium remaining in the entire continuous southern chromium plume as of the Fourth Quarter of 2019. 2019 calculations were conducted with adjustment of the saturated thickness due to the drought. The method for calculating Cr(VI) mass treated by in situ treatment and mass of Cr(VI) remaining is more difficult and subject to uncertainty than estimates of Cr(VI) mass removed by extraction and agricultural treatment, as detailed in Appendix B.

ATU = Agricultural Treatment Unit

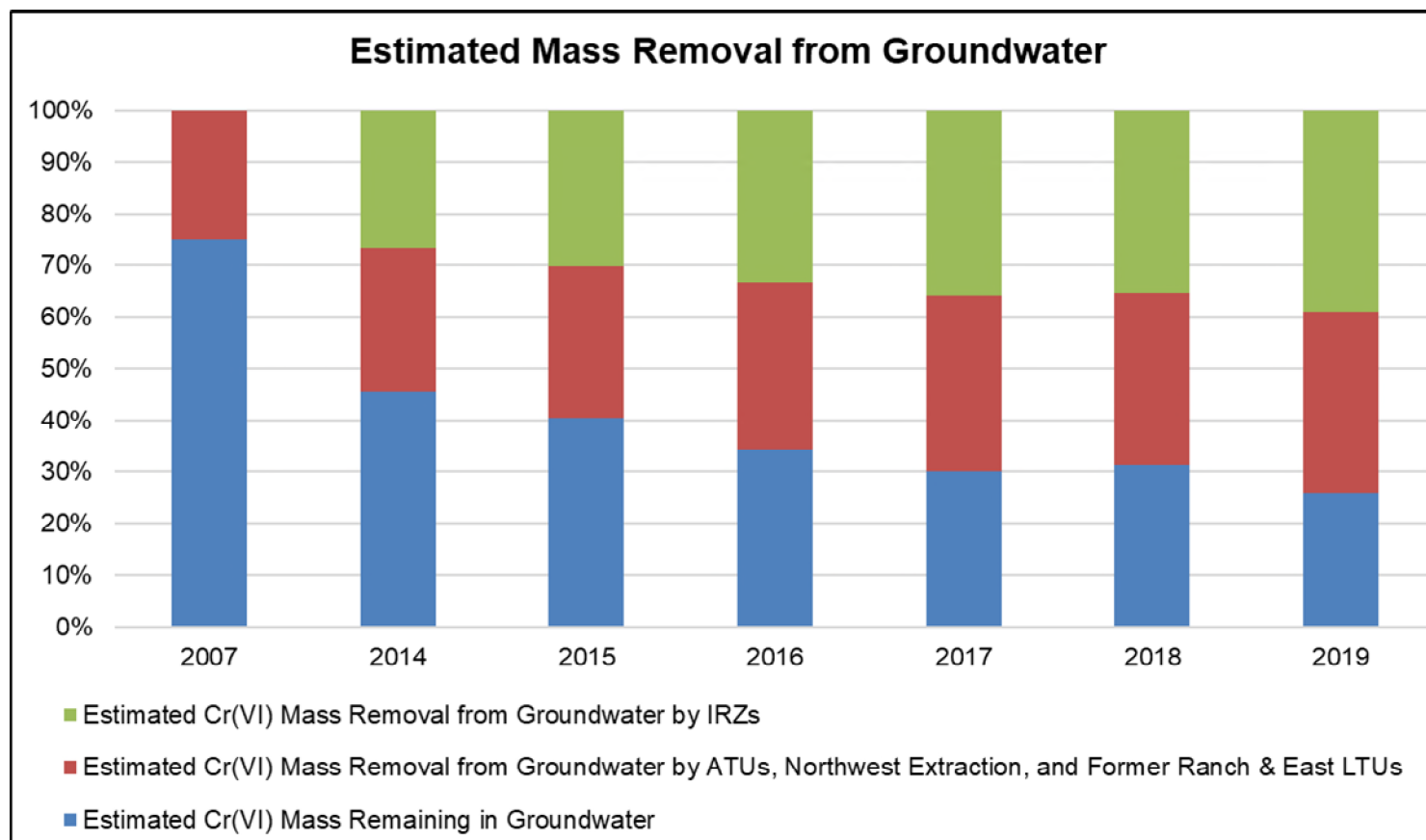
Cr(VI) = hexavalent chromium

IRZ = In Situ Reactive Zone

LTU = Land Treatment Unit

FOUR-YEAR COMPREHENSIVE CLEANUP STATUS AND
EFFECTIVENESS REPORT (2016 TO 2019)
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY, CALIFORNIA

**ESTIMATED Cr(VI) MASS REMOVED AND
MASS REMAINING OVER TIME**



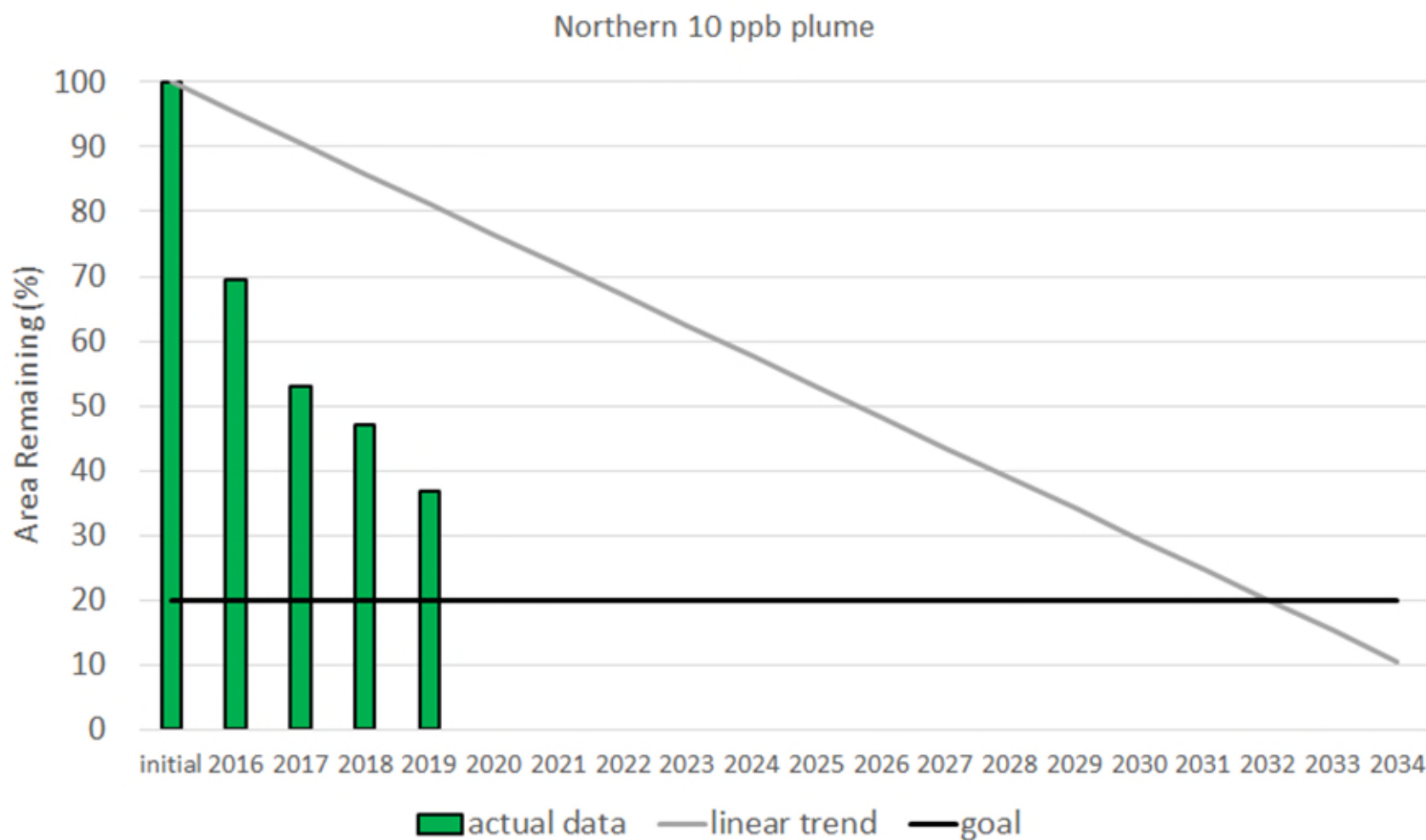
Notes:

1. The mass of chromium removed by IRZ treatment was calculated as the difference in the estimate of Cr(VI) mass present in groundwater south of Highway 58 prior to full-scale IRZ operation (baseline) and the estimate of Cr(VI) mass present in groundwater at subsequent time steps (i.e., Fourth Quarter of 2018, Fourth Quarter of 2019) and was corrected for Cr(VI) removed by the southern ATUs, as documented in Appendix B. A similar calculation was made for the mass of chromium remaining in the entire continuous southern chromium plume as of the Fourth Quarter of 2019. 2019 calculations were conducted with adjustment of the saturated thickness due to the drought. The method for calculating Cr(VI) mass treated by in situ treatment and mass of Cr(VI) remaining is more difficult and subject to uncertainty than estimates of Cr(VI) mass removed by extraction and agricultural treatment, as detailed in Appendix B.

ATU = Agricultural Treatment Unit
 Cr(VI) = Hexavalent Chromium
 IRZ = In Situ Reactive Zone
 LTU = Land Treatment Unit

FOUR-YEAR COMPREHENSIVE CLEANUP STATUS AND
 EFFECTIVENESS REPORT (2016 TO 2019)
 PACIFIC GAS AND ELECTRIC COMPANY
 HINKLEY, CALIFORNIA

**ESTIMATED Cr(VI) MASS REMOVED FROM
 GROUNDWATER AND MASS REMAINING OVER TIME**



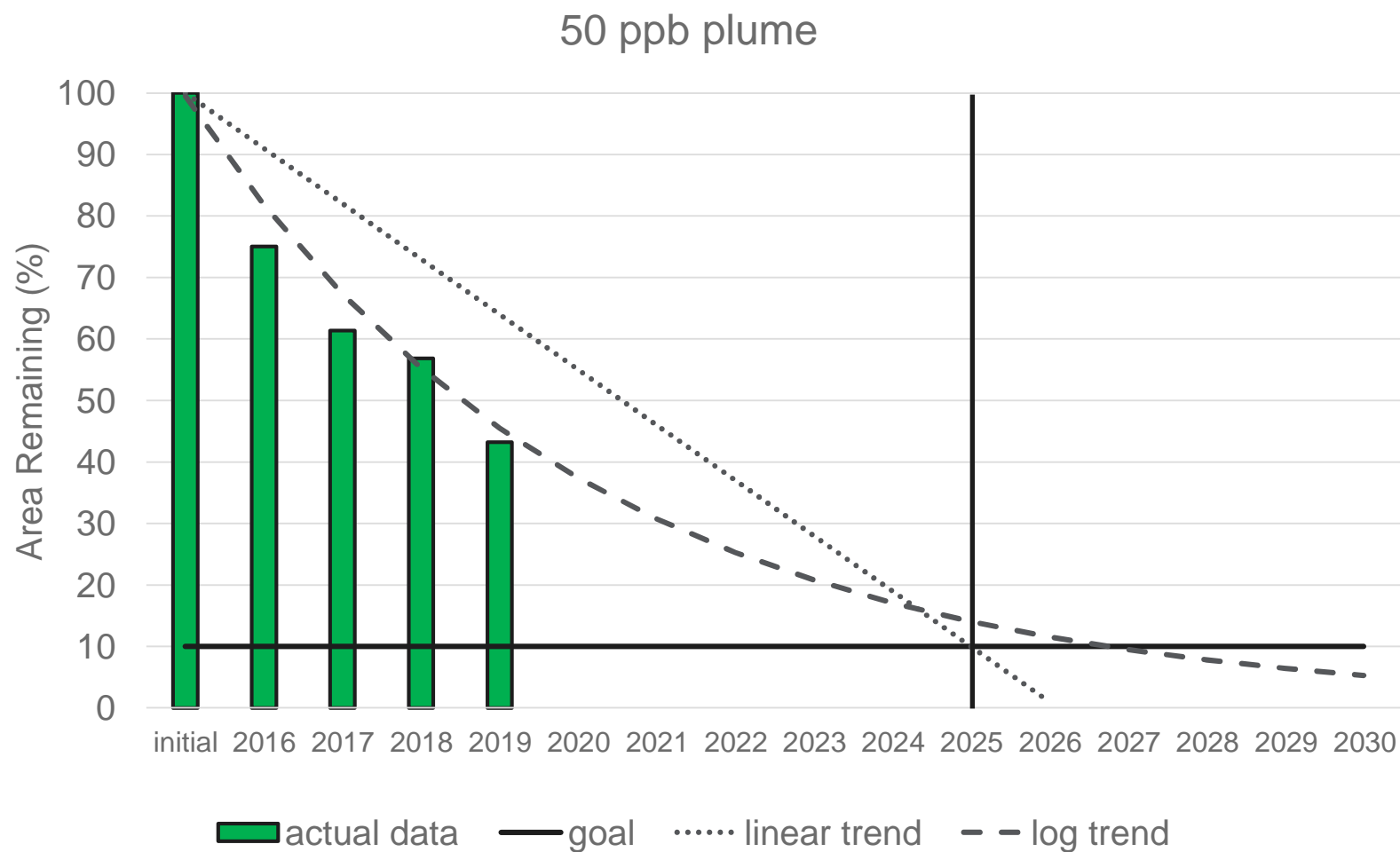
Notes:

1. Area remaining was calculated as specified in the Cleanup and Abatement Order Monitoring and Reporting Program, using the wells listed in Table 8-1, as the percentage of wells with chromium concentrations greater than 10 parts per billion over the total number of wells (49).

ppb = parts per billion

FOUR-YEAR COMPREHENSIVE CLEANUP STATUS AND
EFFECTIVENESS REPORT (2016 TO 2019)
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY, CALIFORNIA

**REMEDIAL PROGRESS
TOWARD 10 PPB GOAL**



Notes:

1. Area remaining was calculated as specified in the Cleanup and Abatement Order Monitoring and Reporting Program, using the wells listed in Table 8-1, as the percentage of wells with chromium concentrations greater than 50 parts per billion over the total number of wells (44).

ppb = parts per billion

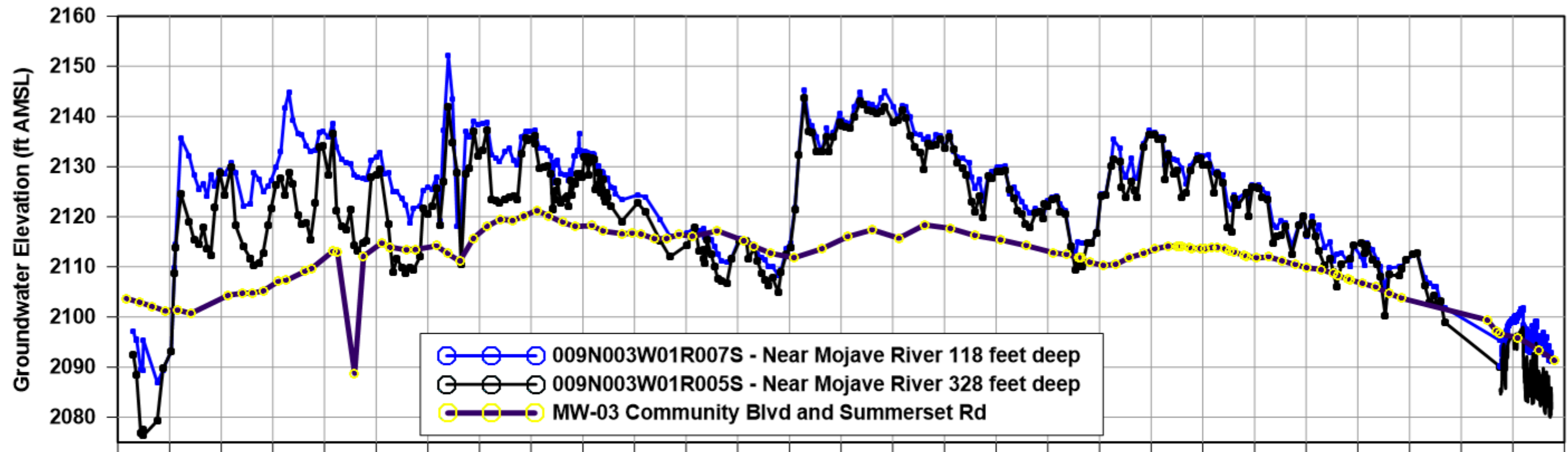
FOUR -EAR COMPREHENSIVE CLEANUP STATUS AND
EFFECTIVENESS REPORT (2016 TO 2019)
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY, CALIFORNIA

**REMEDIAL PROGRESS
TOWARD 50 PPB GOAL**

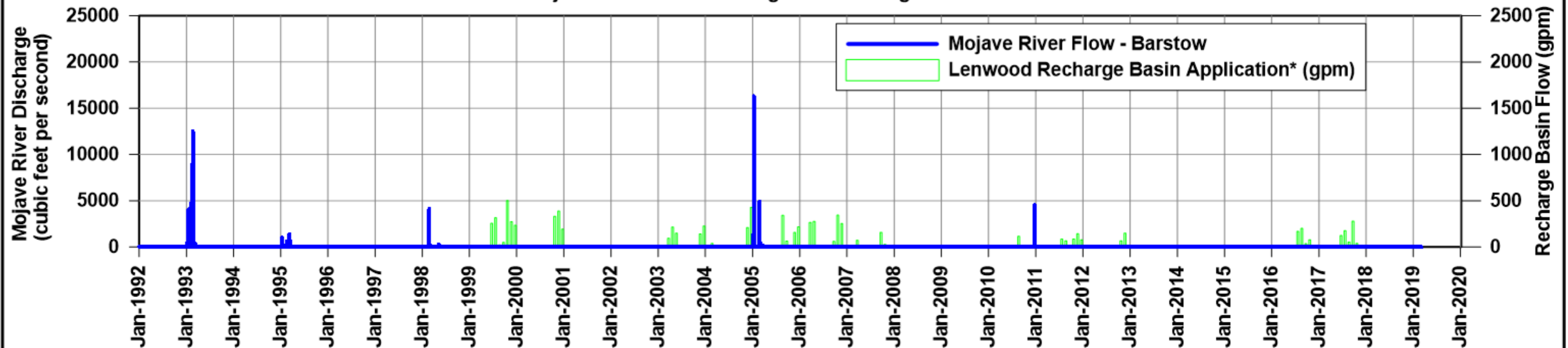
ARCADIS | Design & Consultancy
for natural and
built assets

FIGURE
3-8

Groundwater Levels

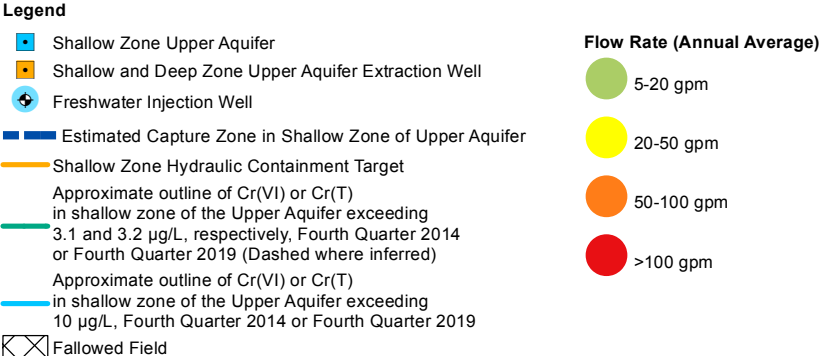
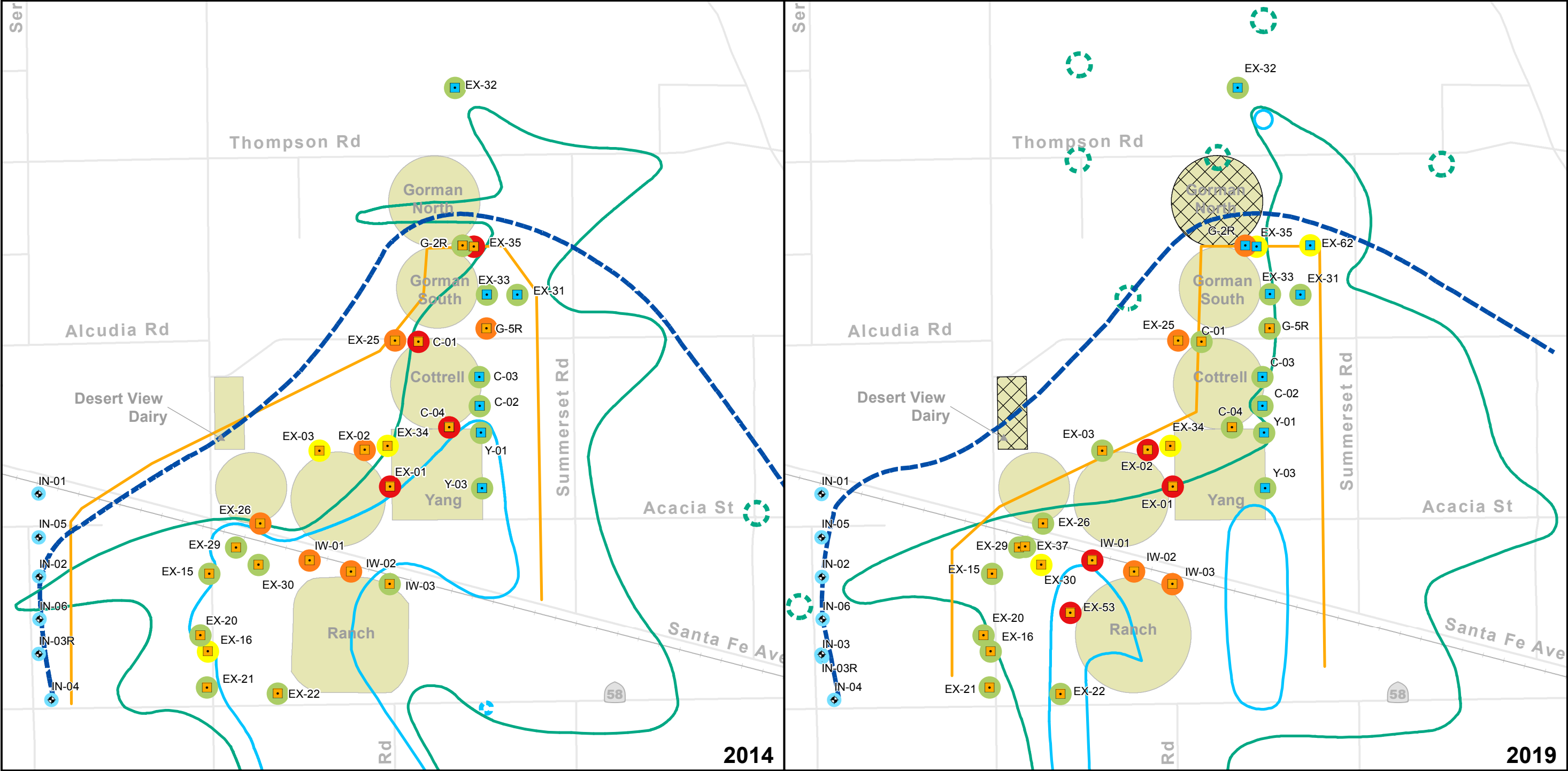


Mojave River Flow Discharge and Recharge Basin Rates



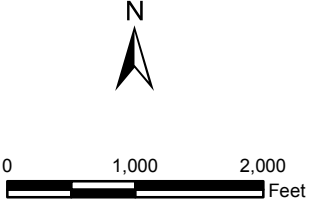
Notes:
 ft AMSL = Feet Above Mean Sea Level
 AF = acre-feet
 Wells 009N002W06M005S and 009N002W06M007S are south and east of Riverview Road near the Mojave River east of Dixie Road.
 *Lenwood recharge applications resumed in 2019, however 2019 data is unavailable

FIGURE 4-3
 GROUNDWATER LEVELS IN RESPONSE TO
 MOJAVE RIVER FLOWS AND LENWOOD RECHARGE BASIN
 FOUR-YEAR COMPREHENSIVE CLEANUP STATUS AND
 EFFECTIVENESS REPORT (2016 TO 2019)
 PACIFIC GAS & ELECTRIC COMPANY,
 HINKLEY COMPRESSOR STATION,
 HINKLEY CALIFORNIA



Notes:

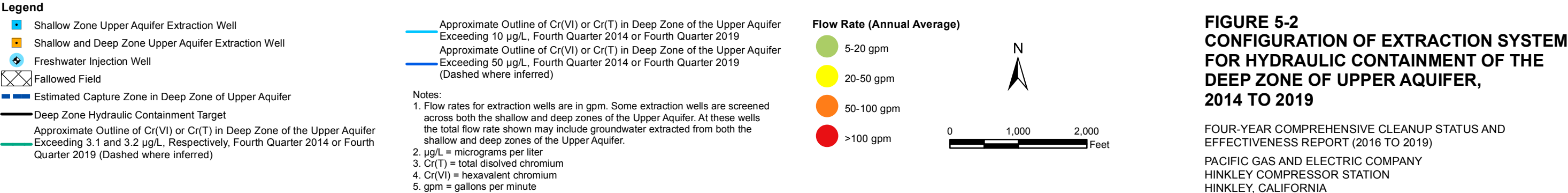
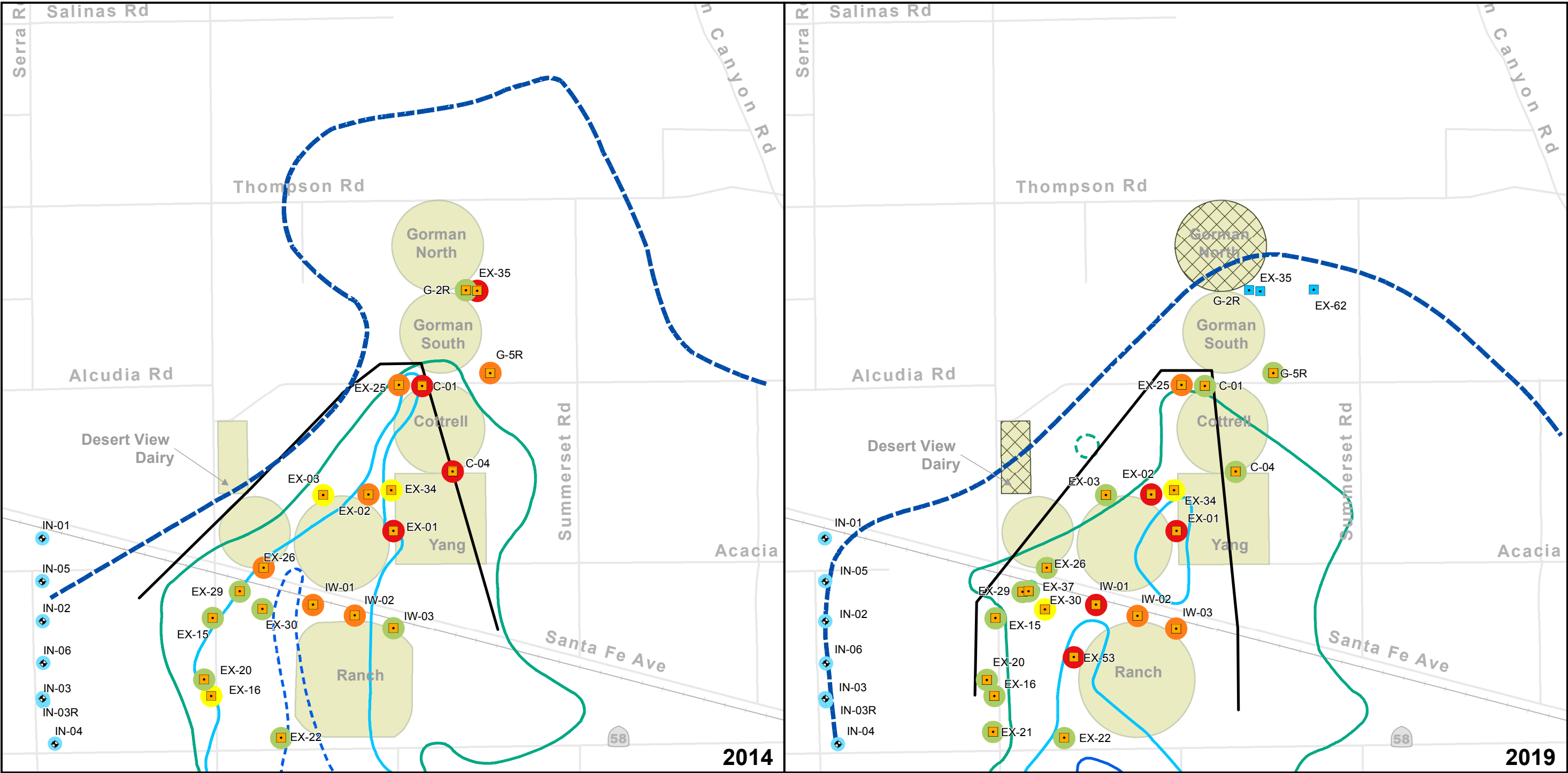
- 2014 and 2019 annual average flow rates for extraction wells are in gpm. Some extraction wells are screened across both the shallow and deep zones of the Upper Aquifer. At these wells the total flow rate shown may include groundwater extracted from both the shallow and deep zones of the Upper Aquifer.
- µg/L = micrograms per liter
- Cr(T) = total dissolved chromium
- Cr(VI) = hexavalent chromium
- gpm = gallons per minute

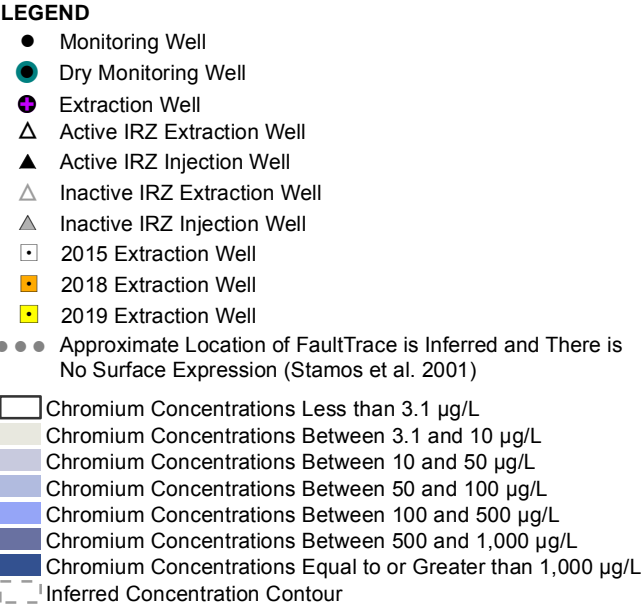


**FIGURE 5-1
CONFIGURATION OF THE EXTRACTION
SYSTEM FOR HYDRAULIC CONTAINMENT
OF THE SHALLOW ZONE OF UPPER AQUIFER,
2014 TO 2019**

FOUR-YEAR COMPREHENSIVE CLEANUP STATUS AND
EFFECTIVENESS REPORT (2016 TO 2019)

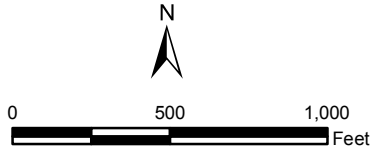
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA





NOTES:
µg/L = Micrograms per Liter
IRZ= In Situ Reactive Zone
NS = Not Sampled
< = Below Reporting Limit (as shown)
*Remedial wells screened across both shallow and deep zones of the upper aquifer; Data not used in contouring
**Well destroyed by Highway 58 construction
*** Data not used in contouring
+ Total dissolved chromium concentration data not used in contouring
+ Location is approximated; survey pending
1 Well dry upon installation and not connected to the injection system

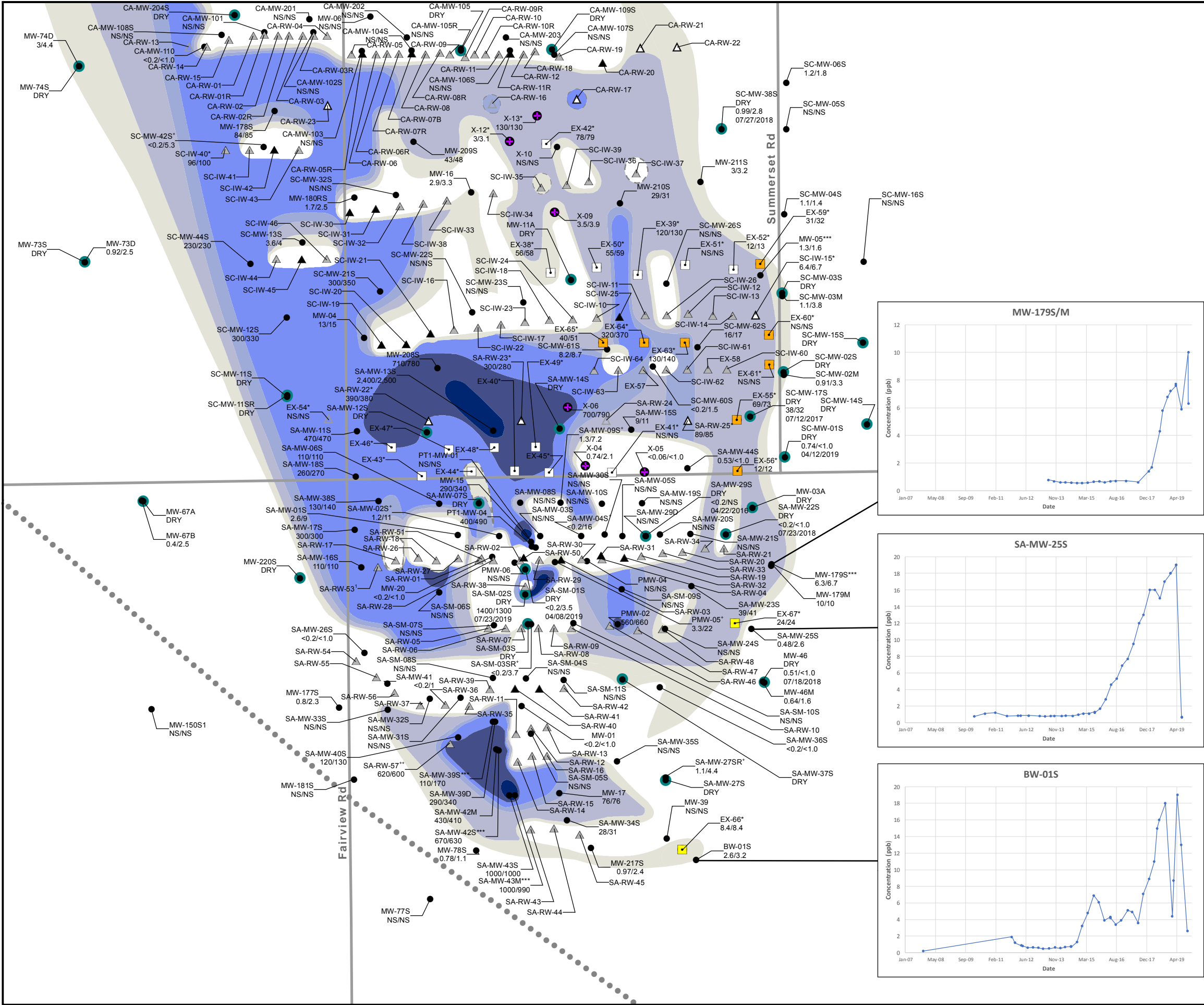
WORK CITED:
Stamos, C.L., P. Martin, T. Nishikawa, and B.F. Cox. 2001. *Simulation of Ground-Water Flow in the Mojave River Basin, California*. U.S. Geological Survey Water-Resources Investigations Report 01-4002, Version 3. Prepared in cooperation with the Mojave Water Agency.

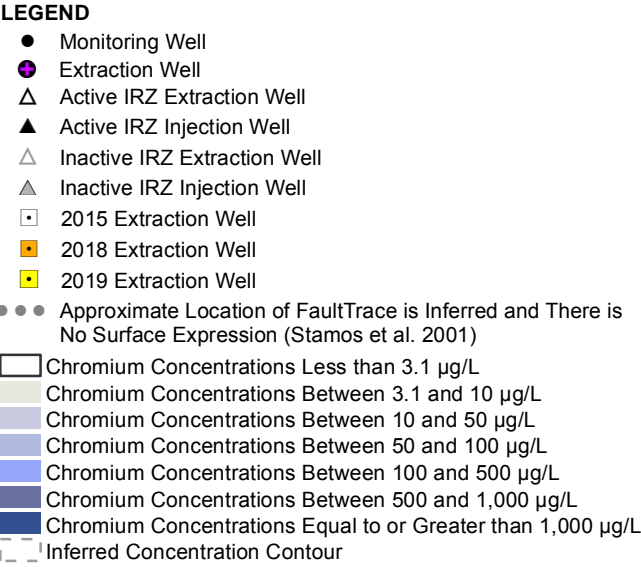


**FIGURE 5-3
CHROMIUM RESULTS FOR SOUTHEAST
AREA OF THE SHALLOW ZONE OF THE
UPPER AQUIFER**

FOUR-YEAR COMPREHENSIVE CLEANUP STATUS AND
EFFECTIVENESS REPORT (2016 TO 2019)

PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA





NOTES:
µg/L = Micrograms per Liter
IRZ= In Situ Reactive Zone
NS = Not Sampled
< = Below Reporting Limit (as shown)
*Remedial wells screened across both shallow and deep zones of the upper aquifer; Data not used in contouring
** Data not used in contouring
+ Total dissolved chromium concentration data not used in contouring
++ Location is approximated; survey pending

WORK CITED:
Stamos, C.L., P. Martin, T. Nishikawa, and B.F. Cox. 2001. *Simulation of Ground-Water Flow in the Mojave River Basin, California*. U.S. Geological Survey Water-Resources Investigations Report 01-4002, Version 3. Prepared in cooperation with the Mojave Water Agency.

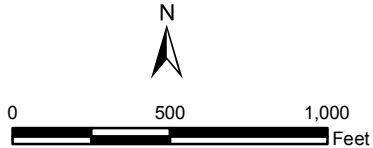
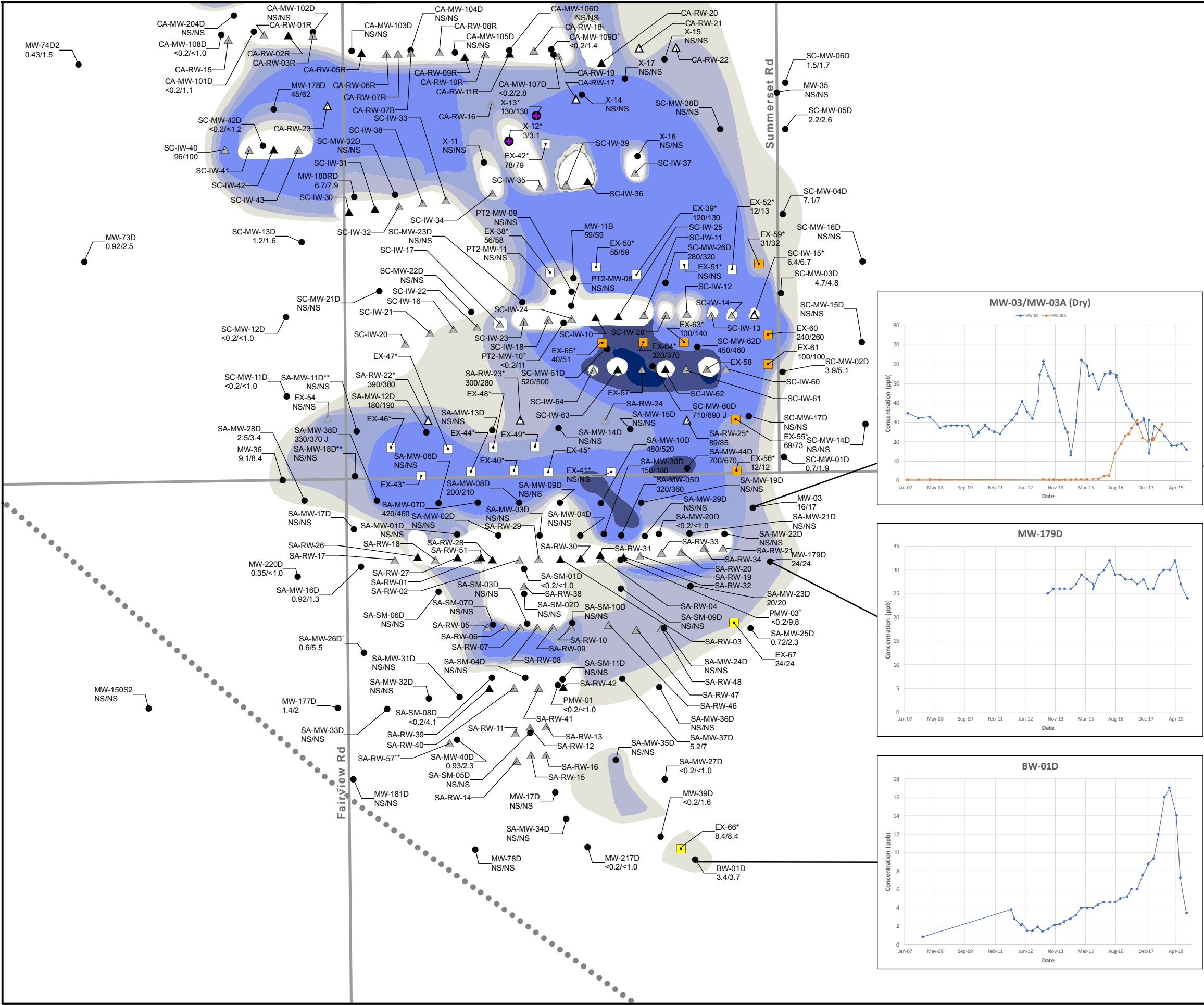
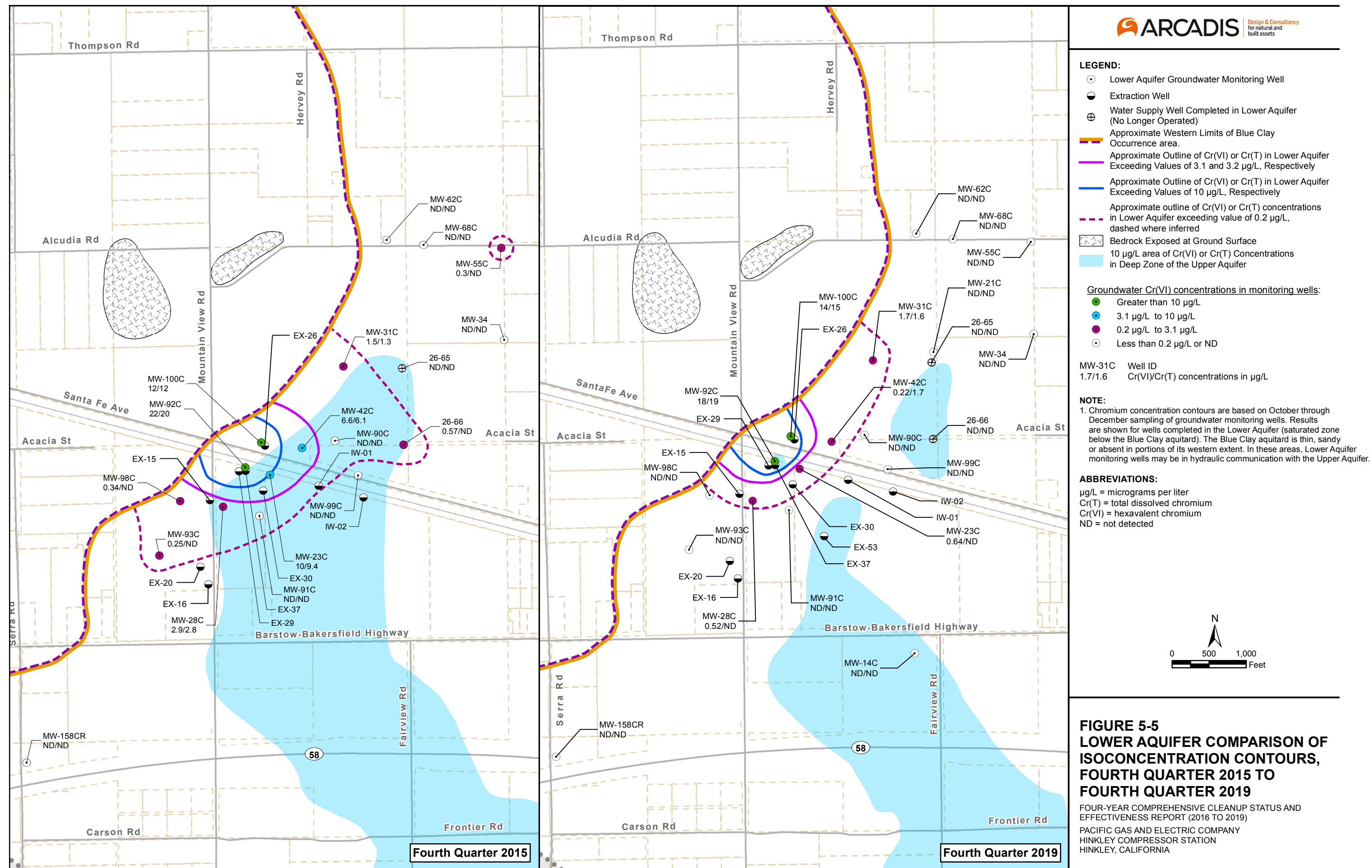


FIGURE 5-4
CHROMIUM RESULTS FOR SOUTHEAST AREA OF THE DEEP ZONE OF THE UPPER AQUIFER
FOUR-YEAR COMPREHENSIVE CLEANUP STATUS AND EFFECTIVENESS REPORT (2016 TO 2019)
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA





LEGEND:

- Lower Aquifer Groundwater Monitoring Well
- Extraction Well
- ⊕ Water Supply Well Completed in Lower Aquifer (No Longer Operated)
- Approximate Western Limits of Blue Clay Occurrence. The Blue Clay does not begin to form an aquitard separating the Upper and Lower Aquifers until east of the grey shaded transitional area.
- Approximate Location of Lockhart Fault; Fault Trace is Inferred, and There is No Surface Expression (Stamos et al. 2001)
- Approximate Outline of Cr(VI) or Cr(T) in Lower Aquifer Exceeding Values of 3.1 and 3.2 µg/L, Respectively, Fourth Quarter 2019
- Approximate Outline of Cr(VI) or Cr(T) in Lower Aquifer Exceeding Values of 10 µg/L, Respectively, Fourth Quarter 2019
- Approximate outline of Cr(VI) or Cr(T) concentrations in Lower Aquifer exceeding value of 0.2 µg/L, Fourth Quarter 2019, dashed where inferred
- Approximate Transitional Area where the Blue Clay is only intermittently present, thin and sandy. There is no Lower Aquifer in this area. Although identified as Lower Aquifer wells with "C" designations, monitoring wells in this area are screened across weathered bedrock at the base of the Upper Aquifer and are not Lower Aquifer monitoring wells.
- ⬢ Bedrock Exposed at Ground Surface
- 10 µg/L area of Cr(VI) or Cr(T) Concentrations in Deep Zone of the Upper Aquifer, Fourth Quarter 2019

Groundwater Cr(VI) concentrations in monitoring wells:

- Greater than 10 µg/L
- 3.1 µg/L to 10 µg/L
- 0.2 µg/L to 3.1 µg/L
- Less than 0.2 µg/L or ND

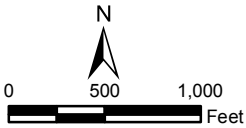
MW-31C 1.7/1.6 Well ID
Cr(VI)/Cr(T) concentrations in µg/L; maximum of primary and duplicate samples during Fourth Quarter 2019 sampling.

NOTE:

1. Chromium concentration contours are based on October through December 2019 sampling of groundwater monitoring wells. Results are shown for wells completed in the Lower Aquifer (saturated zone below the Blue Clay aquitard). The Blue Clay aquitard is thin, sandy or absent in portions of its western extent. In these areas, Lower Aquifer monitoring wells may be in hydraulic communication with the Upper Aquifer.

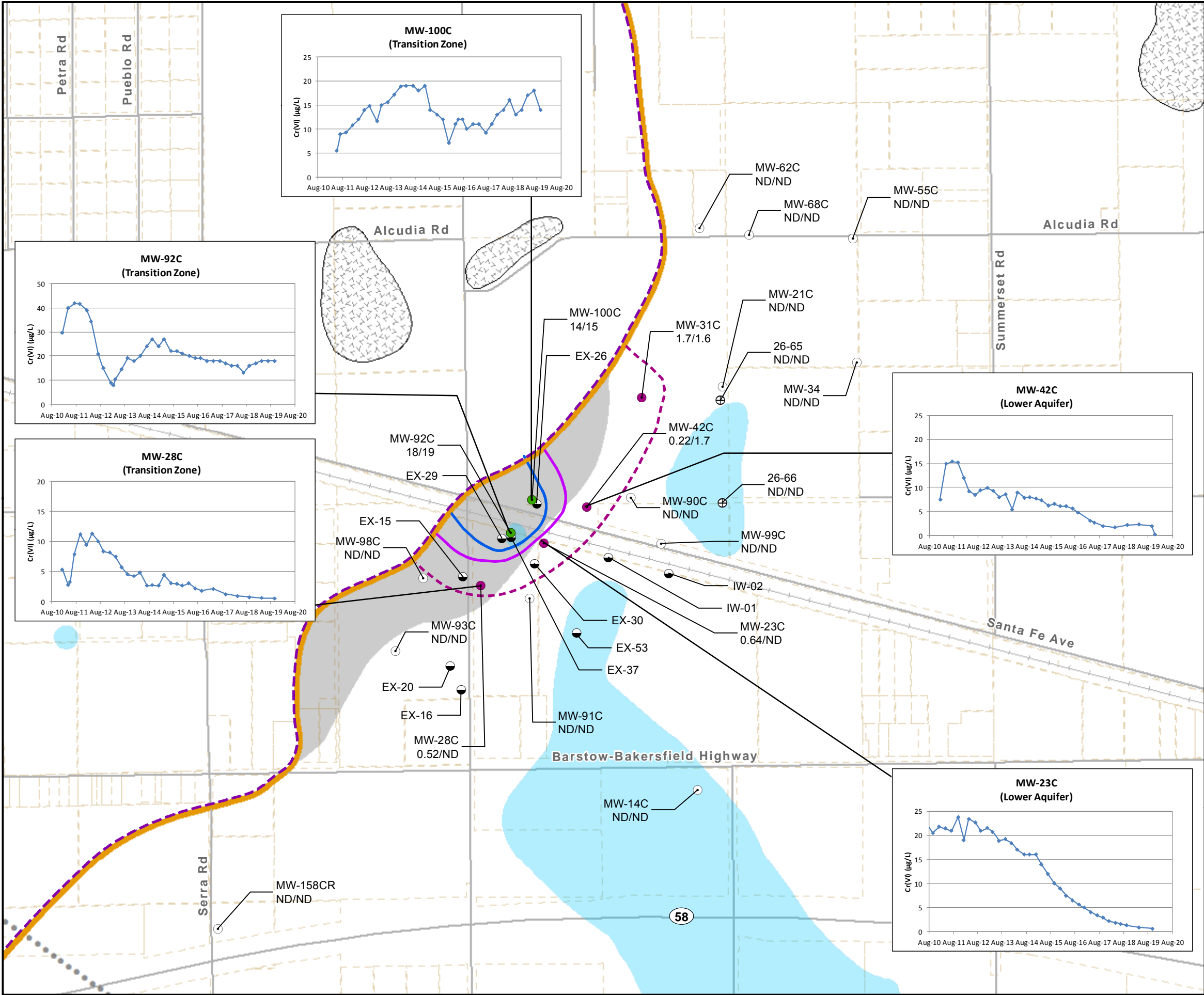
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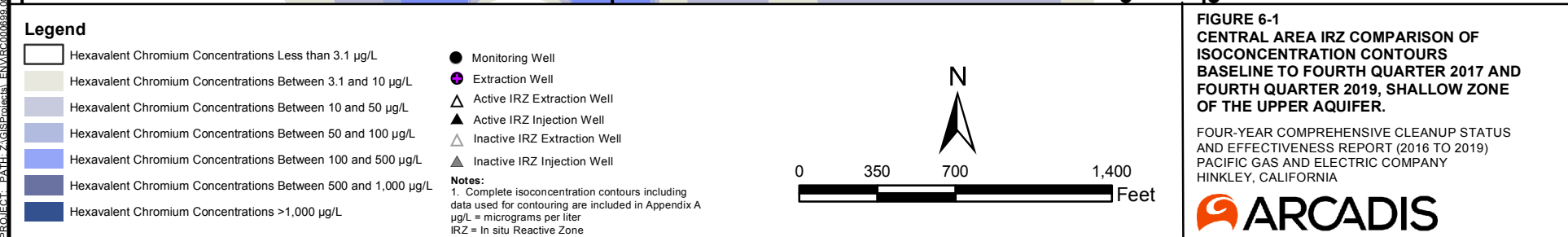
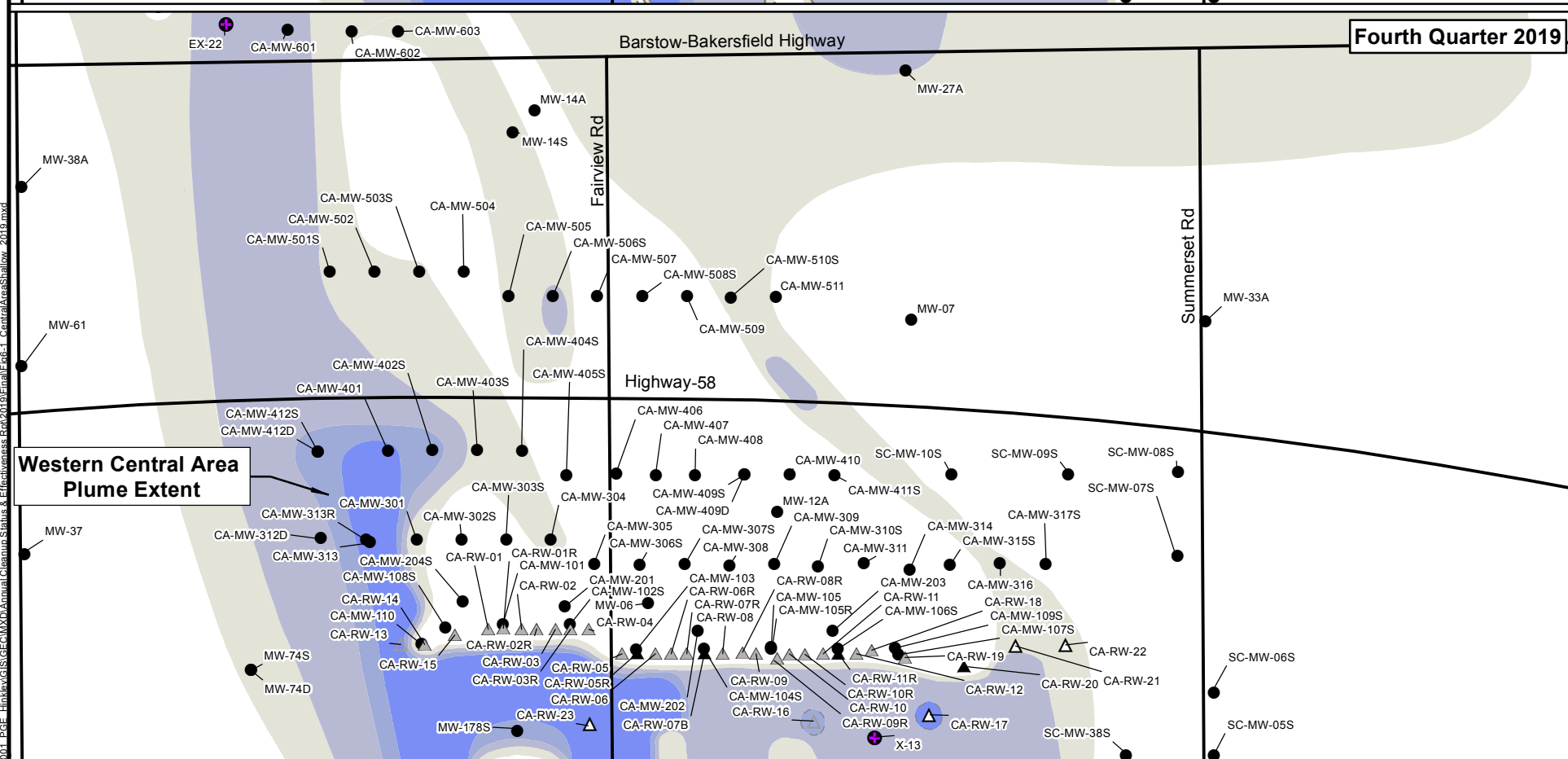
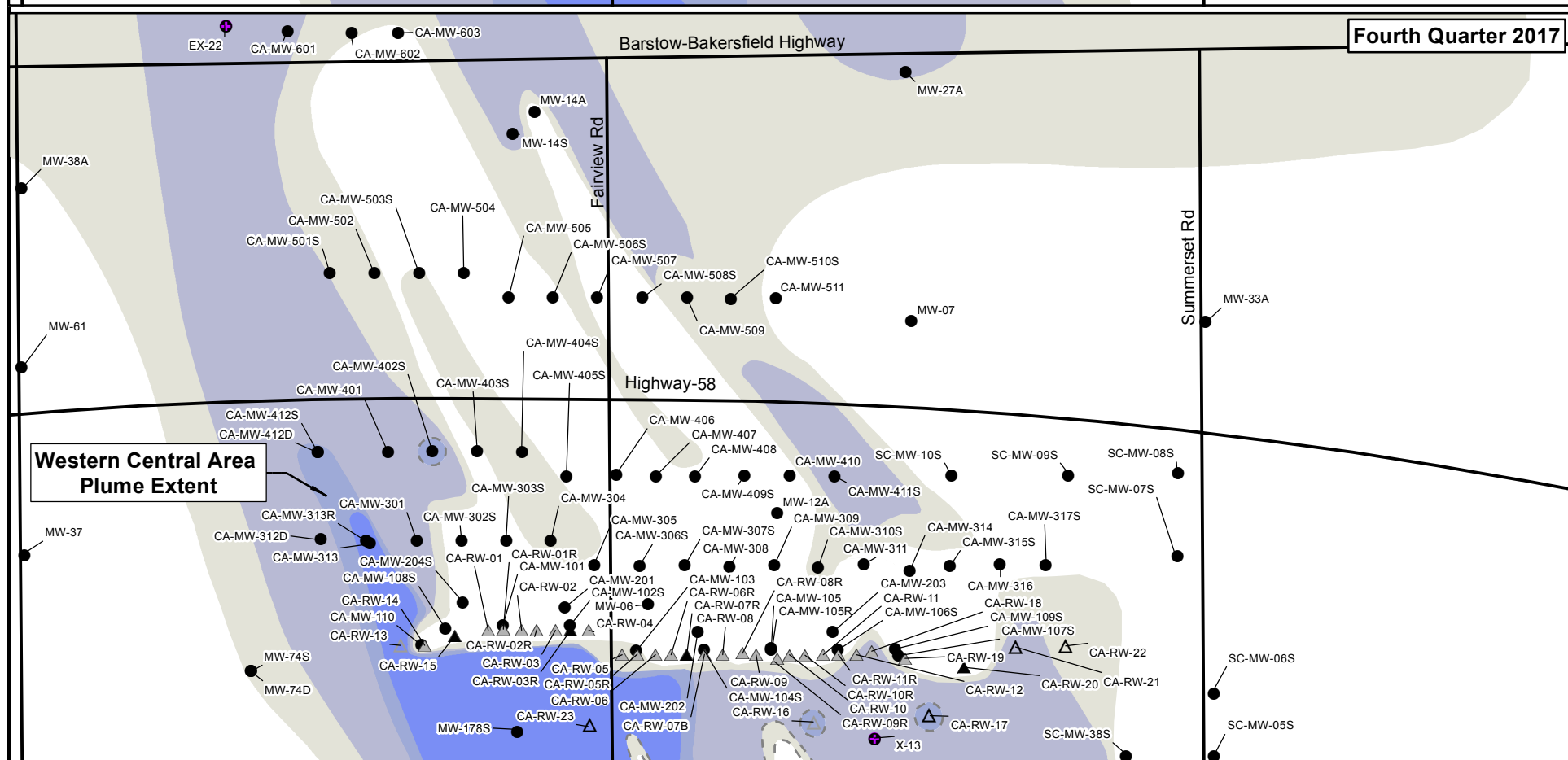
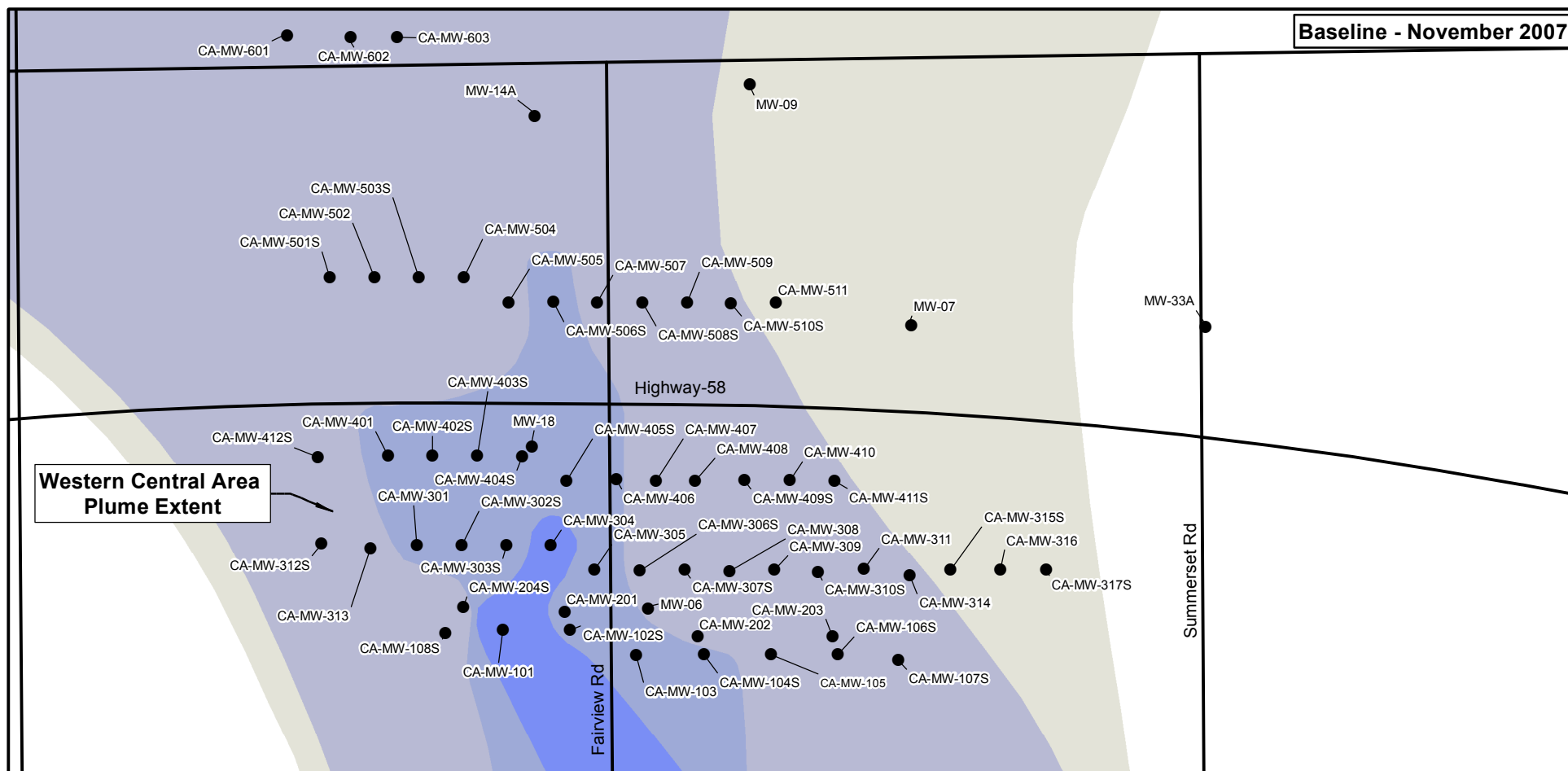
µg/L = micrograms per liter
Cr(T) = total dissolved chromium
Cr(VI) = hexavalent chromium
ND = not detected

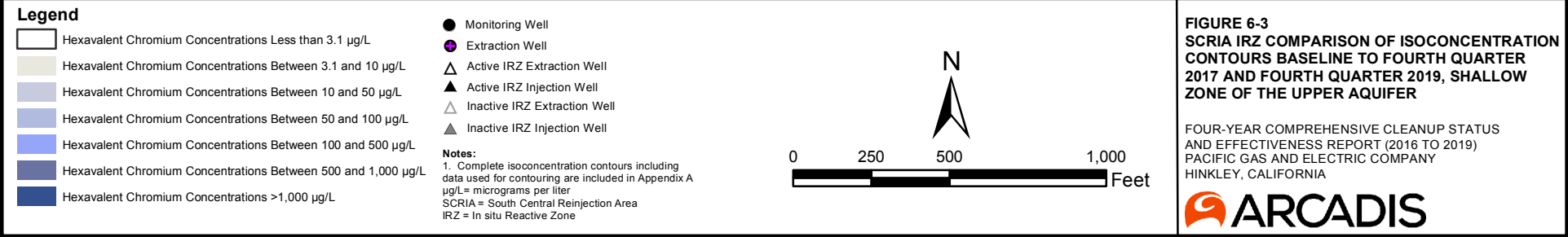
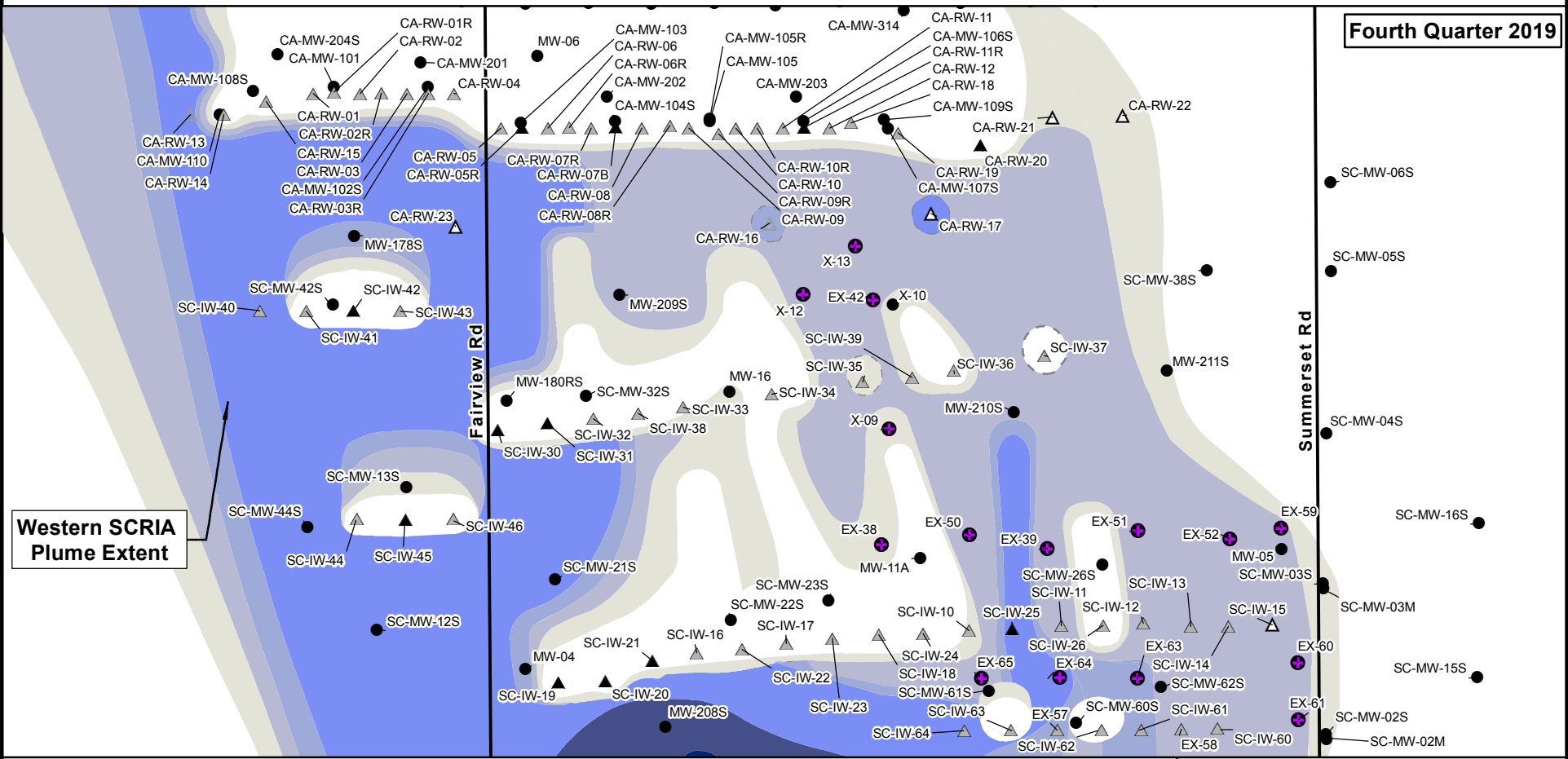
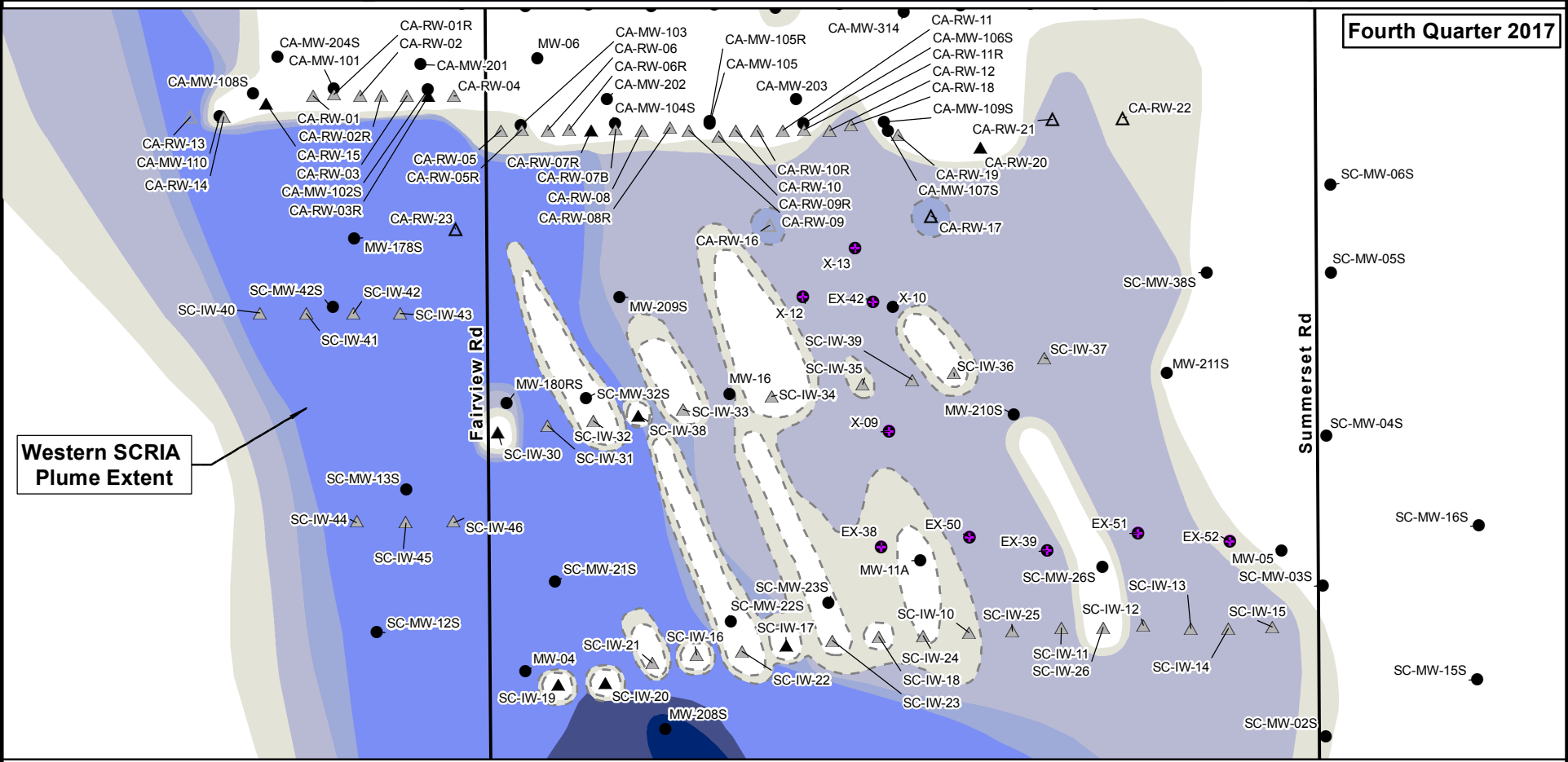
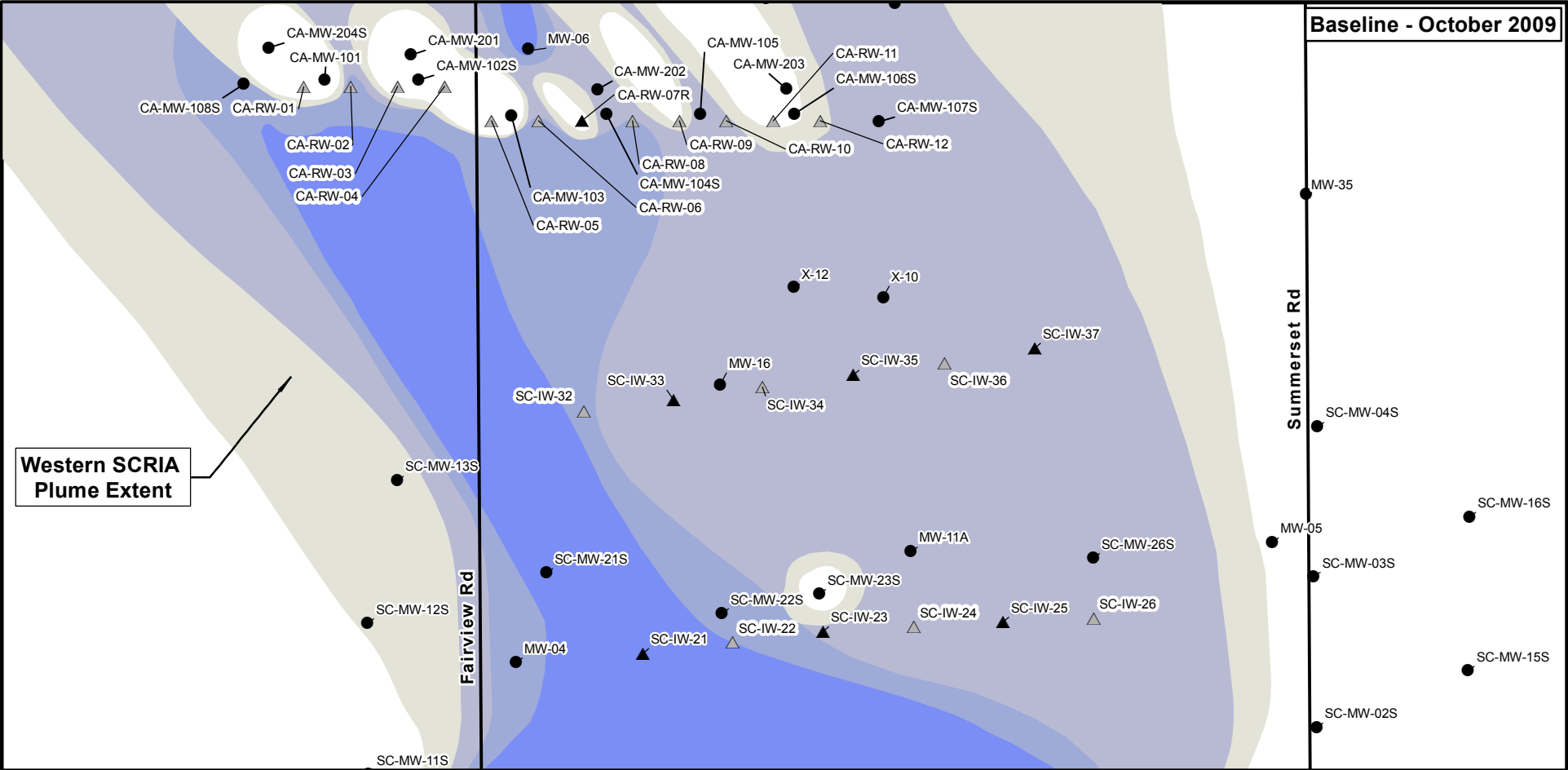


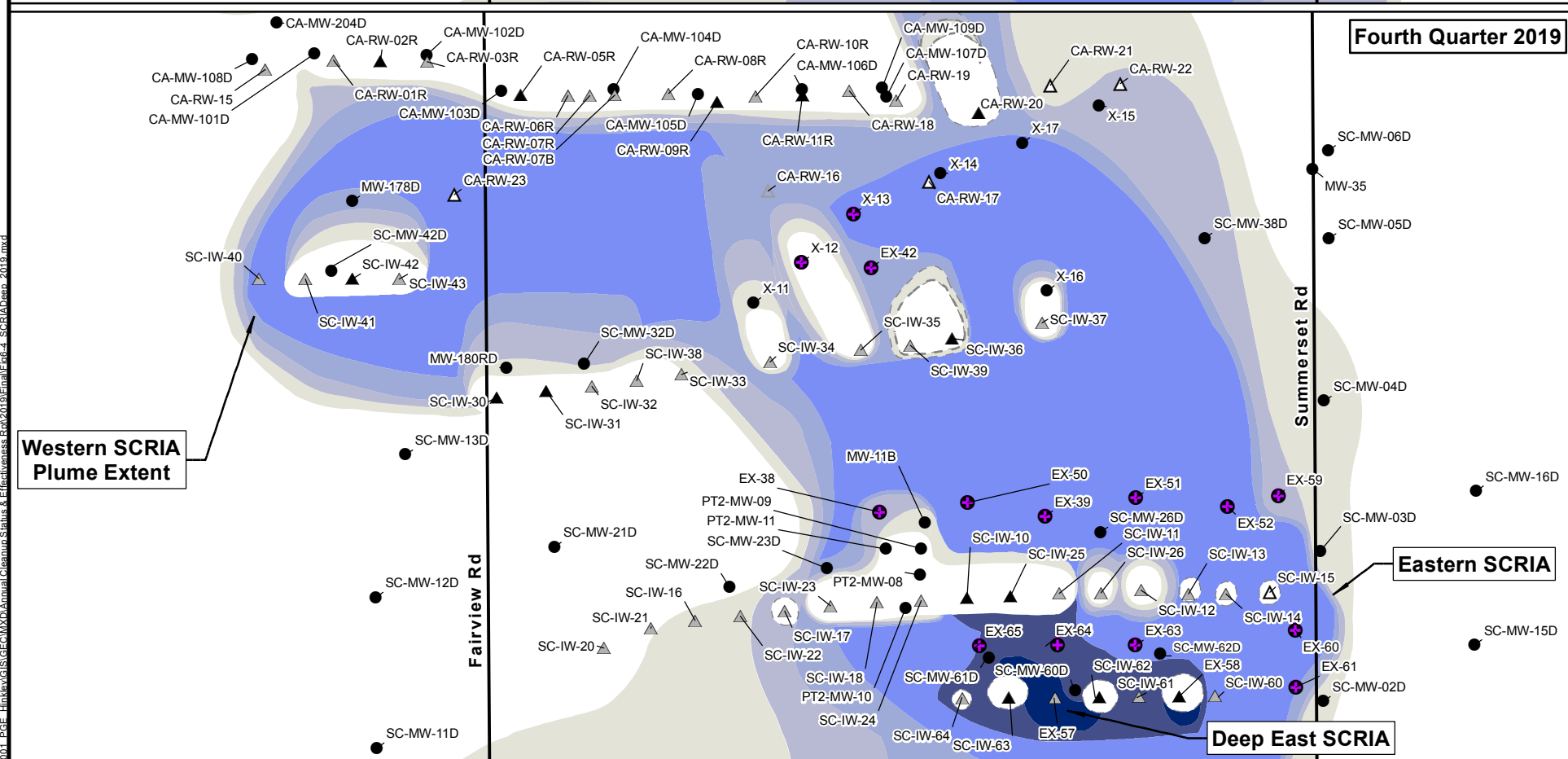
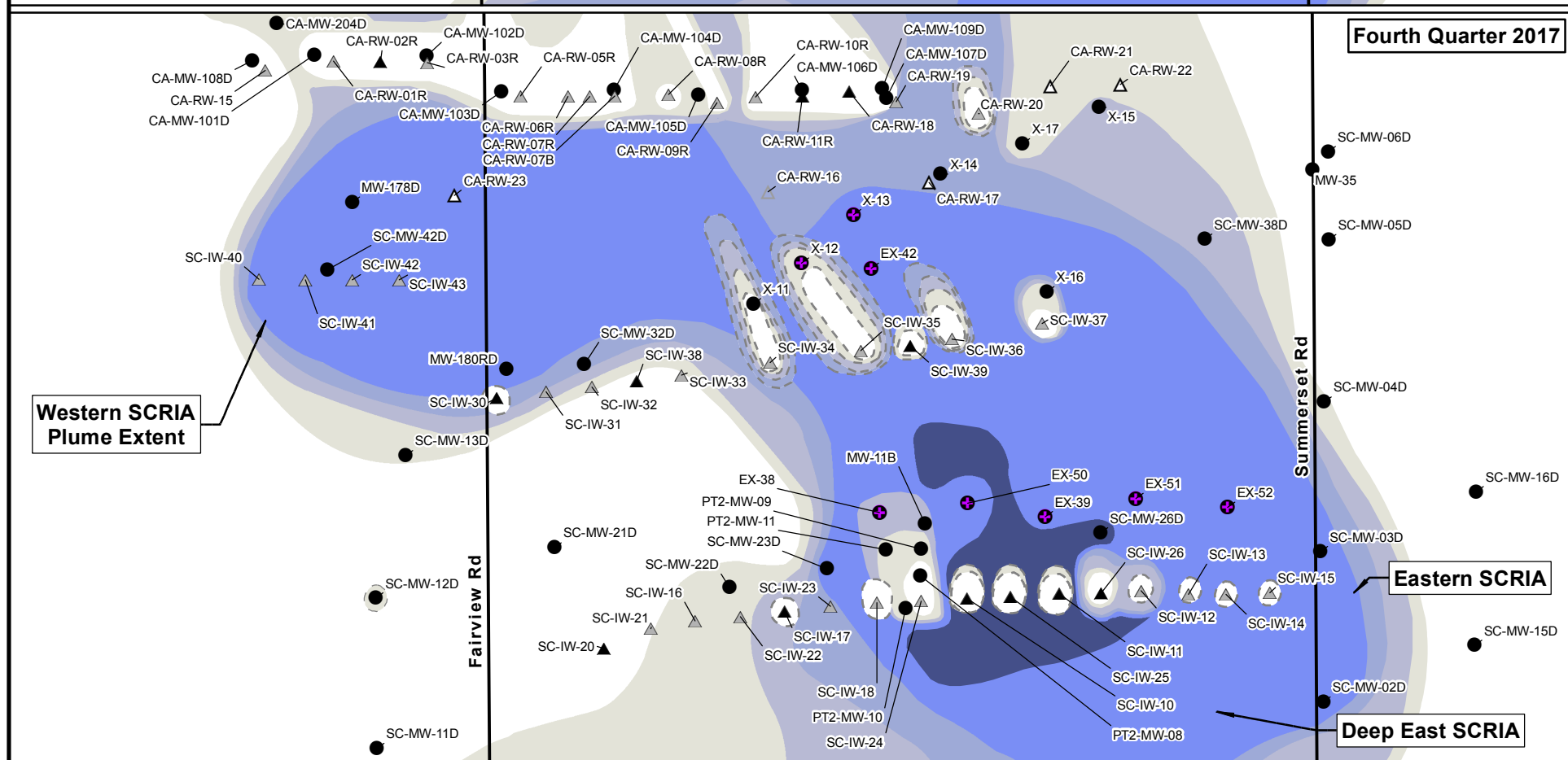
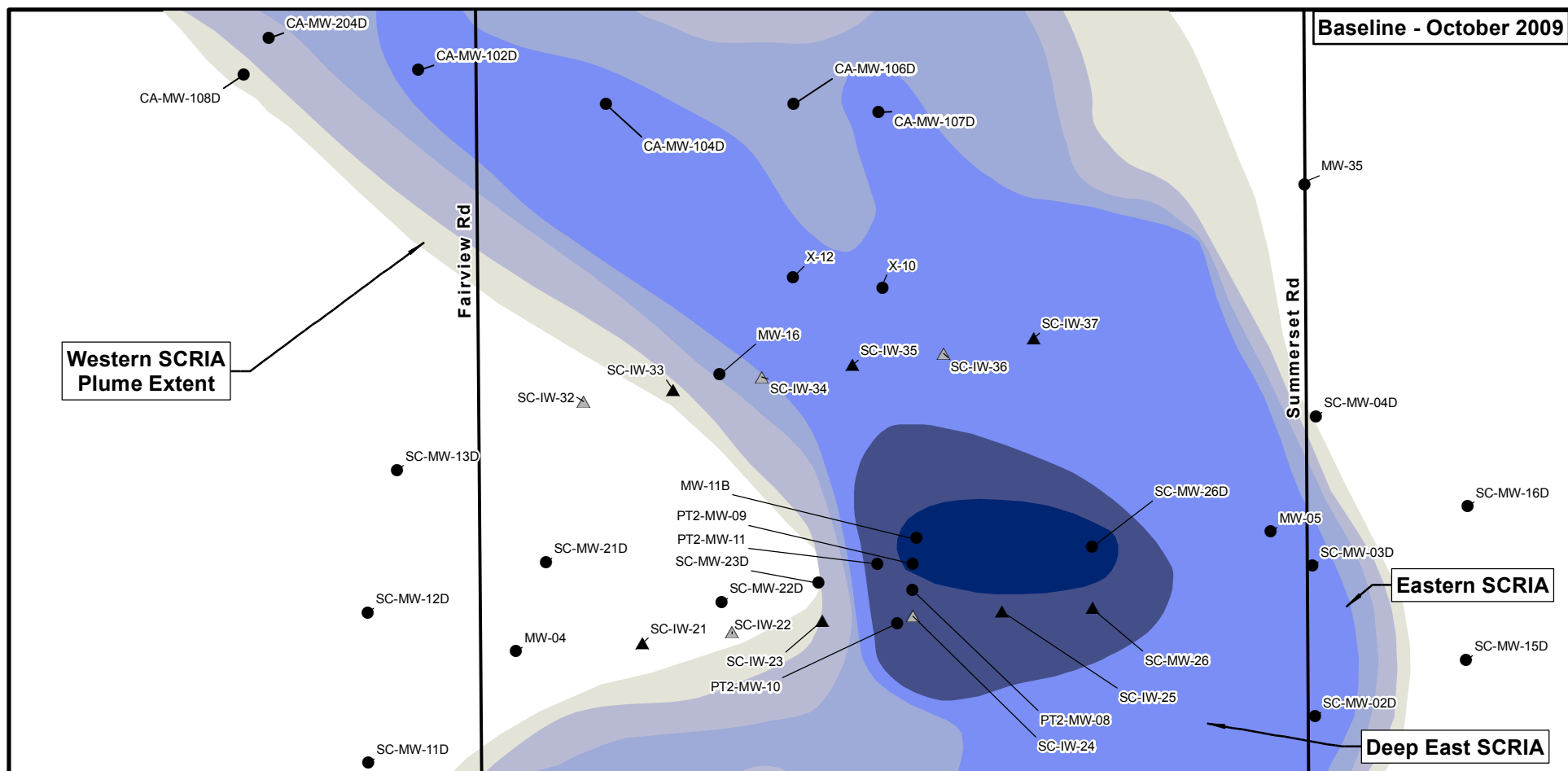
**FIGURE 5-6
CHROMIUM RESULTS FOR LOWER
AQUIFER GROUNDWATER
MONITORING AND DOMESTIC WELLS,
FOURTH QUARTER 2019**

FOUR-YEAR COMPREHENSIVE CLEANUP STATUS AND
EFFECTIVENESS REPORT (2016 TO 2019)
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA

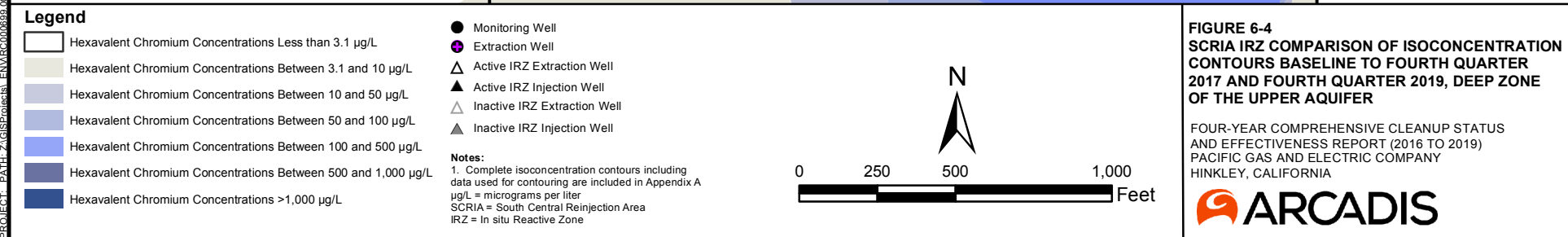


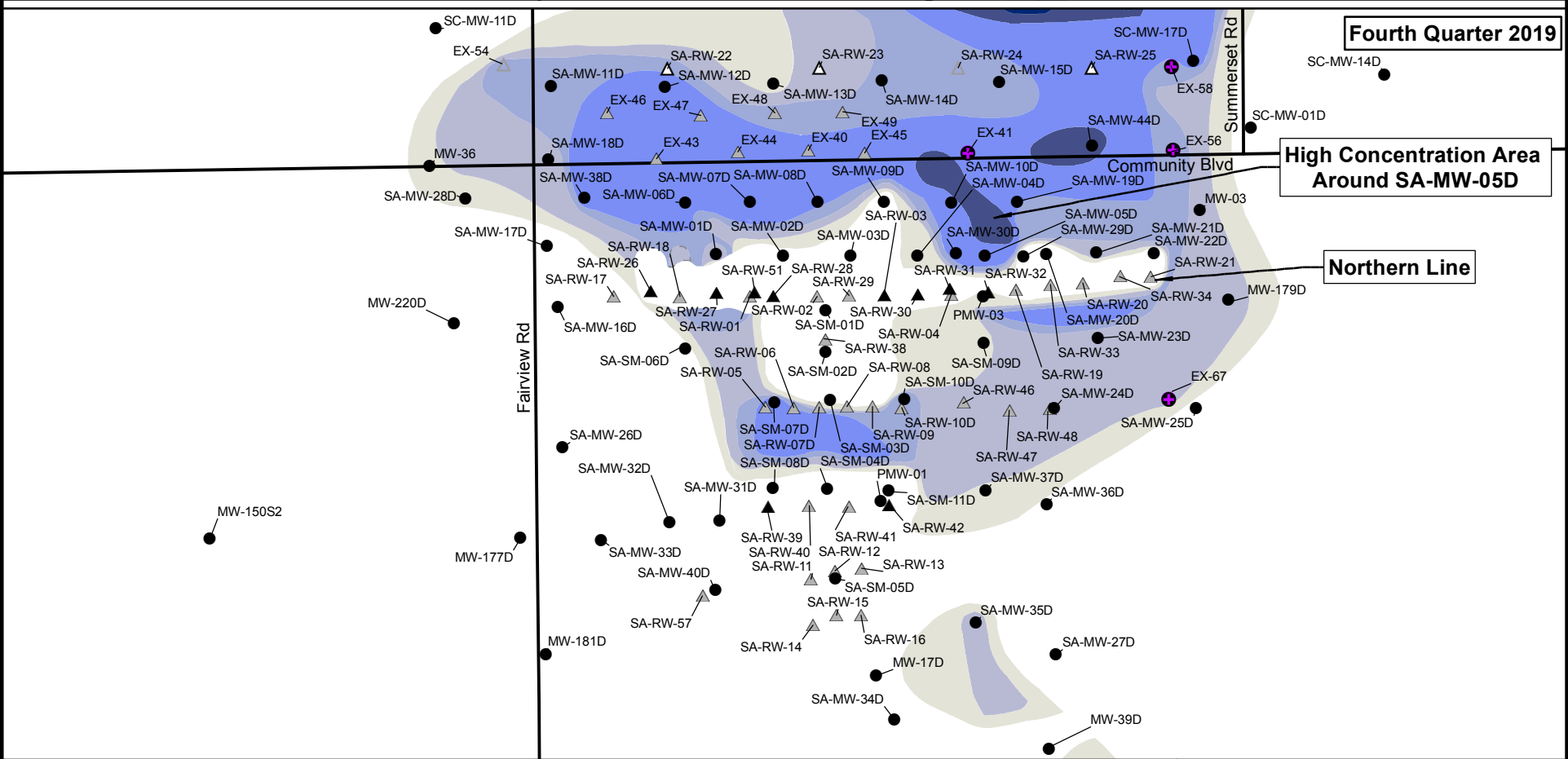
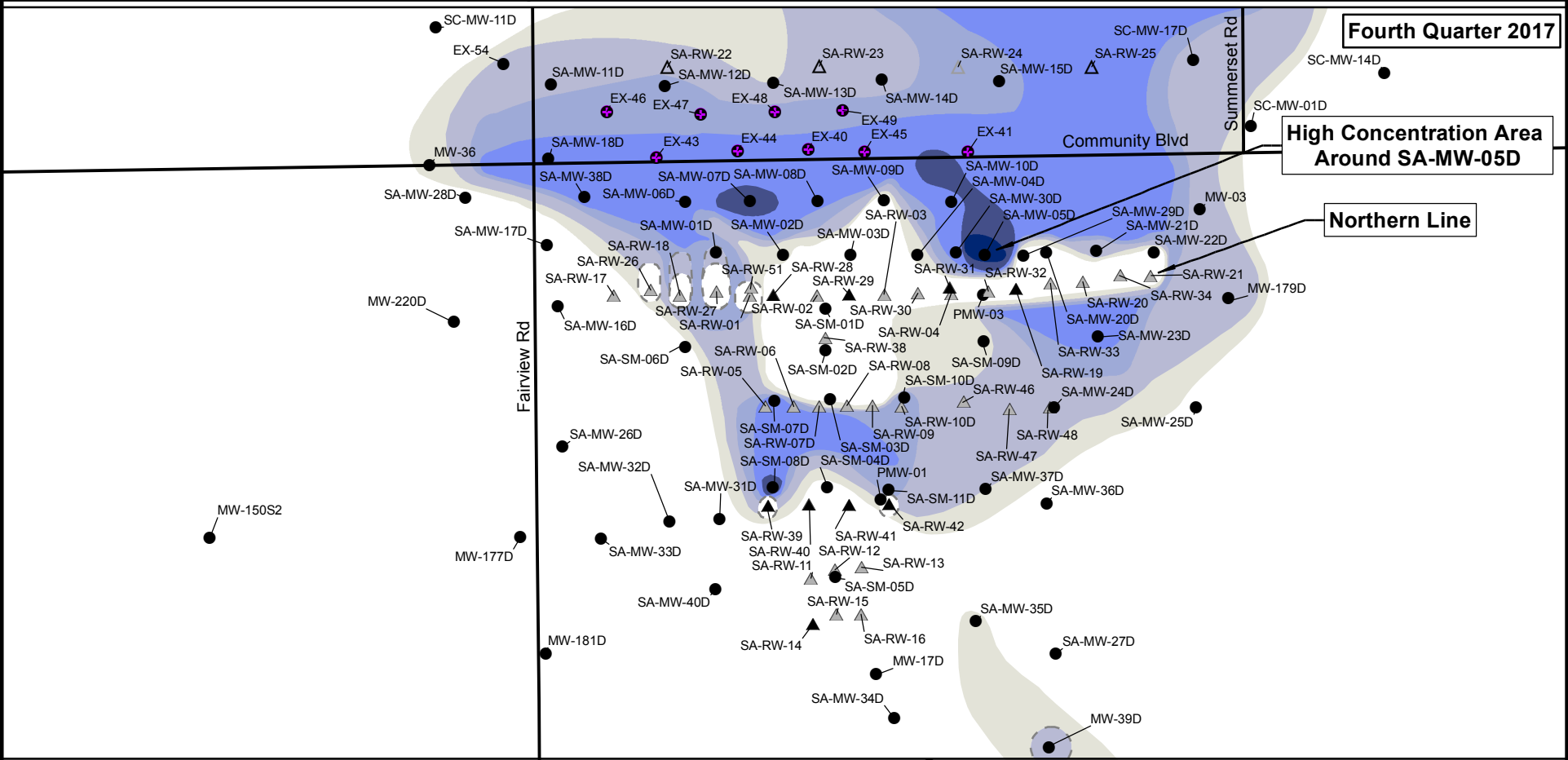
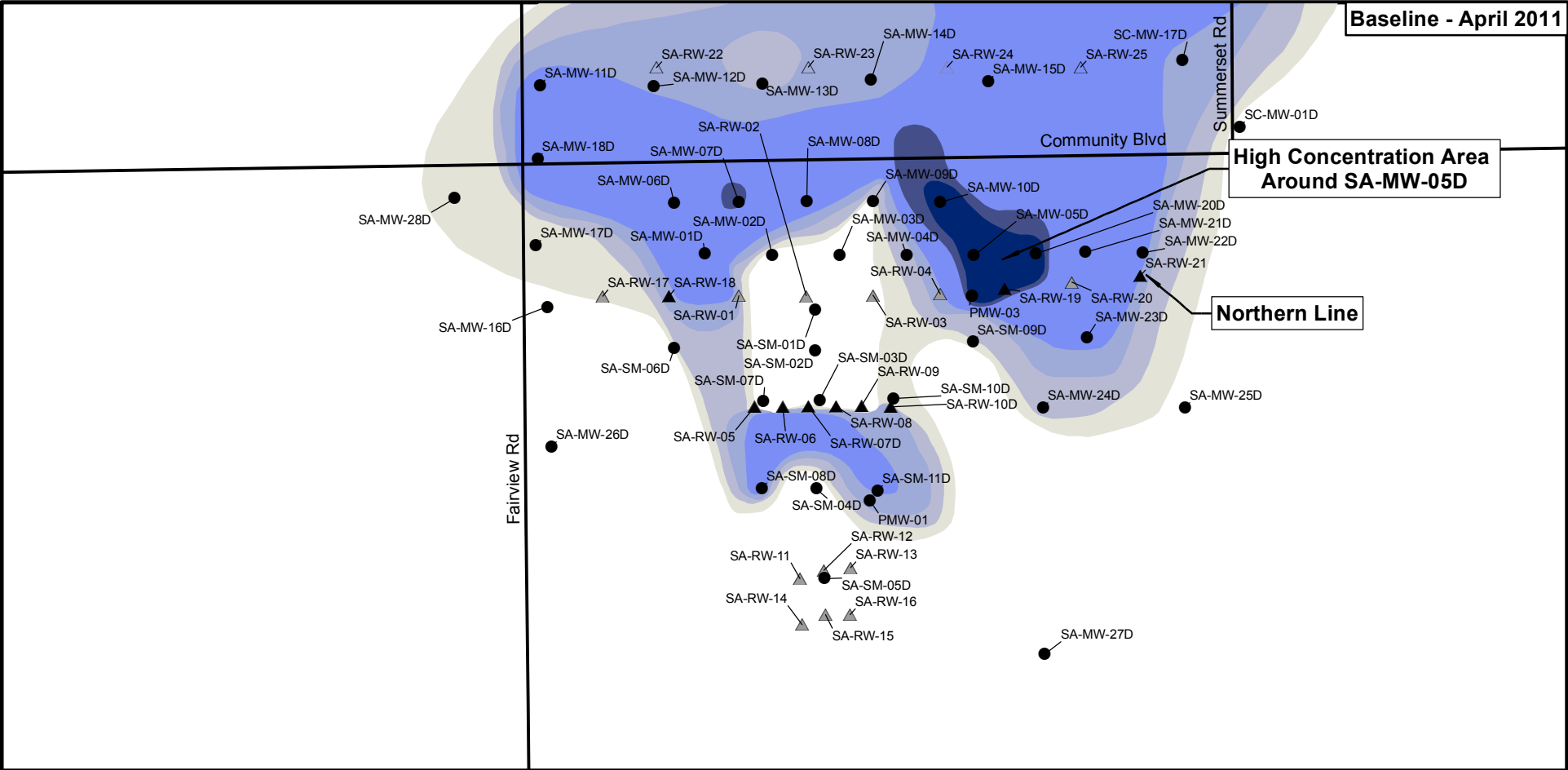






CITY:(DEN-TECH) DIV:GROUP:(ENV/GIS) DB: <ACP>PS101045</ACP> LD: PIC: PM: TM:
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Legend

- Hexavalent Chromium Concentrations Less than 3.1 µg/L
- Hexavalent Chromium Concentrations Between 3.1 and 10 µg/L
- Hexavalent Chromium Concentrations Between 10 and 50 µg/L
- Hexavalent Chromium Concentrations Between 50 and 100 µg/L
- Hexavalent Chromium Concentrations Between 100 and 500 µg/L
- Hexavalent Chromium Concentrations Between 500 and 1,000 µg/L
- Hexavalent Chromium Concentrations >1,000 µg/L

- Monitoring Well
- Extraction Well
- Active IRZ Extraction Well
- Active IRZ Injection Well
- Inactive IRZ Extraction Well
- Inactive IRZ Injection Well

Notes:
1. Complete isoconcentration contours including data used for contouring are included in Appendix A
µg/L = micrograms per liter
IRZ = In situ Reactive Zone

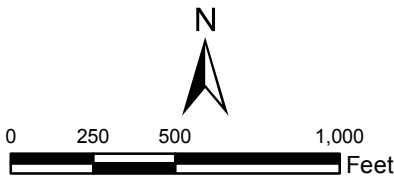


FIGURE 6-6
SOURCE AREA IRZ COMPARISON OF
ISOCONCENTRATION CONTOURS BASELINE TO
FOURTH QUARTER 2017 AND FOURTH QUARTER
2019, DEEP ZONE OF THE UPPER AQUIFER

FOUR-YEAR COMPREHENSIVE CLEANUP STATUS
AND EFFECTIVENESS REPORT (2016 TO 2019)
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY, CALIFORNIA



APPENDIX A

Operations Data and Supporting Information



Table 3-3
Summary of Discharges to Groundwater, Central Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

95% Ethanol-Original Injection System													
Period	CA-RW-01	CA-RW-02	CA-RW-03	CA-RW-04	CA-RW-05	CA-RW-06	CA-RW-07R	CA-RW-08	CA-RW-09	CA-RW-10	CA-RW-11	CA-RW-12	Total Original System
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	3	0	0	0	45	40	33	0	0	0	0	0	121
February 2019	0	0	0	0	33	23	11	0	0	0	0	0	66
March 2019	0	0	0	0	12	17	5	0	0	0	0	0	34
April 2019	0	0	0	0	0	26	6	0	0	0	0	0	32
May 2019	0	0	0	0	0	35	0	0	0	0	0	0	35
June 2019	0	0	0	0	0	35	0	0	0	0	0	0	35
July 2019	0	0	0	0	0	31	0	0	0	0	0	0	31
August 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
September 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
October 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Project to Date	1,101	490	448	55	1,313	2,981	1,921	2,667	2,097	1,397	2,357	0	16,826

95% Ethanol-Expansion Injection System																		
Period	CA-RW-01R	CA-RW-02R	CA-RW-03R	CA-RW-05R	CA-RW-06R	CA-RW-07B	CA-RW-08R	CA-RW-09R	CA-RW-10R	CA-RW-11R	CA-RW-12	CA-RW-14	CA-RW-15	CA-RW-18	CA-RW-19	CA-RW-20	Total Expanded System	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	0	34	92	0	0	0	10	0	0	0	0	80	34	119	369	490
February 2019	0	4	17	9	84	12	5	43	18	13	0	0	0	64	30	112	410	476
March 2019	0	12	15	0	102	37	43	29	14	37	0	0	0	0	23	66	379	413
April 2019	0	0	19	0	133	45	25	27	16	34	0	0	0	11	47	86	443	475
May 2019	0	0	32	0	110	42	11	16	28	19	0	0	0	0	43	84	386	421
June 2019	0	0	24	6	90	25	26	28	27	14	0	0	0	0	47	61	349	385
July 2019	0	16	30	0	0	50	18	30	21	43	0	0	0	59	0	109	375	406
August 2019	0	63	0	0	0	75	9	28	0	57	0	0	0	0	0	220	452	452
September 2019	0	75	0	5	0	74	30	11	31	21	0	0	0	0	0	151	399	399
October 2019	0	24	0	11	0	38	21	48	6	73	0	0	0	0	0	195	416	416
November 2019	0	78	0	20	0	52	0	51	0	30	0	0	0	0	0	129	360	360
December 2019	0	131	5	67	0	40	0	68	14	6	0	0	0	0	0	105	435	435
Fourth Quarter 2019 Subtotal	0	233	5	99	0	130	21	166	20	109	0	0	0	0	0	429	1,211	1,211
Total Project to Date	933	1,957	962	1,629	2,397	1,475	549	1,261	662	1,112	0	256	2,120	1,598	3,105	4,246	24,734	41,560

Table 3-3
Summary of Discharges to Groundwater, Central Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

60% Sodium Lactate													
Period	CA-RW-01	CA-RW-02	CA-RW-03	CA-RW-04	CA-RW-05	CA-RW-06	CA-RW-07R	CA-RW-08	CA-RW-09	CA-RW-10	CA-RW-11	CA-RW-12	Total
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
February 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
March 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
April 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
May 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
June 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
July 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
August 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
September 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
October 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Project to Date	1,405	24	1,657	0	1,819	65	3,146	102	2,614	78	2,813	0	13,723

Recirculated Groundwater - Original Injection System													
Period	CA-RW-01	CA-RW-02	CA-RW-03	CA-RW-04	CA-RW-05	CA-RW-06	CA-RW-07R	CA-RW-08	CA-RW-09	CA-RW-10	CA-RW-11	CA-RW-12	Total
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume ^a (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume ^a (gallons)
January 2019	19,929	0	0	0	601,592	193,398	189,992	0	0	0	0	0	1,004,911
February 2019	0	0	0	0	461,463	153,373	70,600	0	0	0	0	0	685,436
March 2019	0	0	0	0	233,428	149,179	66,291	0	0	0	0	0	448,898
April 2019	0	0	0	0	0	201,809	28,408	0	0	0	0	0	230,217
May 2019	0	0	0	0	0	268,107	0	0	0	0	0	0	268,107
June 2019	0	0	0	0	0	287,011	0	0	0	0	0	0	287,011
July 2019	0	0	0	0	0	200,580	0	0	0	0	0	0	200,580
August 2019	0	0	0	0	0	3	0	0	0	0	0	0	3
September 2019	0	97	0	0	0	0	6	0	0	0	0	0	103
October 2019	0	43	0	0	0	0	0	0	0	0	0	0	43
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	0	43	0	0	0	0	0	0	0	0	0	0	43
Total Project to Date	7,490,936	3,348,379	8,044,140	3,606,188	16,446,398	15,821,233	36,086,742	16,918,549	18,382,987	8,204,617	16,760,347	0	145,580,700

Table 3-3
Summary of Discharges to Groundwater, Central Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Recirculated Groundwater - Expanded Injection System																		
Period	CA-RW-01R	CA-RW-02R	CA-RW-03R	CA-RW-05R	CA-RW-06R	CA-RW-07B	CA-RW-08R	CA-RW-09R	CA-RW-10R	CA-RW-11R	CA-RW-12	CA-RW-14	CA-RW-15	CA-RW-18	CA-RW-19	CA-RW-20	Total Expanded System	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	0	478,328	651,128	0	0	13,420	122,928	0	0	0	0	1,029,284	398,054	762,940	3,456,082	4,460,993
February 2019	0	57,292	333,447	184,888	707,288	211,656	258,622	714,916	293,291	342,577	0	0	0	871,260	352,738	878,960	5,206,935	5,892,371
March 2019	0	96,736	256,506	134	927,176	661,464	744,352	497,444	237,545	619,573	0	0	0	16	271,594	604,532	4,917,072	5,365,970
April 2019	0	676	289,746	0	944,784	656,652	312,726	382,936	246,806	518,106	0	0	0	198,222	580,814	593,636	4,725,104	4,955,321
May 2019	0	0	485,342	0	834,432	650,308	181,791	249,126	429,841	267,497	0	0	0	0	545,034	609,468	4,252,839	4,520,946
June 2019	0	0	395,610	0	735,640	368,528	388,703	427,544	411,337	243,414	0	0	0	0	677,798	426,468	4,075,042	4,362,053
July 2019	0	144,140	400,245	10	6,426	786,536	249,610	404,312	257,917	517,687	0	0	0	785,642	92,630	669,588	4,314,743	4,515,323
August 2019	0	415,500	0	0	0	1,015,456	143,480	312,456	0	736,885	0	0	0	0	0	1,394,336	4,018,113	4,018,116
September 2019	2	524,042	0	78,786	0	1,007,956	464,469	74,408	453,395	252,497	0	0	0	0	0	934,624	3,790,179	3,790,282
October 2019	0	248,232	0	234,648	0	537,800	300,899	636,564	112,634	831,336	0	0	0	0	0	1,269,604	4,171,717	4,171,760
November 2019	0	631,006	0	311,540	0	814,810	6	763,520	0	433,066	0	0	0	0	0	894,516	3,848,464	3,848,464
December 2019	0	824,702	53,842	845,312	0	469,732	0	799,026	167,605	46,104	0	0	0	0	0	685,236	3,891,559	3,891,559
Fourth Quarter 2019 Subtotal	0	1,703,940	53,842	1,391,500	0	1,822,342	300,905	2,199,110	280,239	1,310,506	0	0	0	0	0	2,849,356	11,911,740	11,911,783
Total Project to Date	14,471,015	27,973,953	16,129,092	34,706,491	31,711,643	29,783,963	12,422,009	24,866,610	16,440,593	17,434,296	13,044	5,291,051	28,998,053	29,364,859	31,716,714	45,086,439	366,409,825	511,990,525

Fluorescein													
Period	CA-RW-01	CA-RW-02	CA-RW-03	CA-RW-04	CA-RW-05	CA-RW-06	CA-RW-07R	CA-RW-08	CA-RW-09	CA-RW-10	CA-RW-11	CA-RW-12	Total
	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)
January 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
February 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
March 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
April 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
May 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
June 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
July 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
August 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
September 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
October 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Project to Date	0	0	0	0	2	0	0	0	0	0	0	0	2

Table 3-3
Summary of Discharges to Groundwater, Central Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Eosine													
Period	CA-RW-01	CA-RW-02	CA-RW-03	CA-RW-04	CA-RW-05	CA-RW-06	CA-RW-07R	CA-RW-08	CA-RW-09	CA-RW-10	CA-RW-11	CA-RW-12	Total
	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)	Total Monthly Mass (pounds)
January 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
February 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
March 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
April 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
May 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
June 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
July 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
August 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
September 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
October 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Project to Date	0	0	0	0	0	0	3	0	0	0	0	0	3

7% Hydrochloric Acid													
Period	CA-RW-01	CA-RW-02	CA-RW-03	CA-RW-04	CA-RW-05	CA-RW-06	CA-RW-07R	CA-RW-08	CA-RW-09	CA-RW-10	CA-RW-11	CA-RW-12	Total
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
February 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
March 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
April 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
May 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
June 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
July 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
August 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
September 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
October 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Project to Date	7	0	10	0	24	0	98	0	10	0	24	0	173

Table 3-3
Summary of Discharges to Groundwater, Central Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

NuWell 120 (pure)													
Period	CA-RW-01	CA-RW-02	CA-RW-03	CA-RW-04	CA-RW-05	CA-RW-06	CA-RW-07R	CA-RW-08	CA-RW-09	CA-RW-10	CA-RW-11	CA-RW-12	Total
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
February 2019	0.2	0	0	0	0	0	0	0	0	0	0	0	0.2
March 2019	0	0	0	0	0.3	0	1.2	0	0	0	0	0	1.5
April 2019	0	0	0	0	0	0.2	0	0	0	0	0	0	0.2
May 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
June 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
July 2019	0	0	0	0	0.1	0	0	0	0	0	0	0	0
August 2019	0	0	0	0	0	0.2	0	0	0	0	0	0	0
September 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
October 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Project to Date	4.8	0	4.6	0	2.1	19.2	45.9	0	0	0	0	0	76.6

NuWell 120 (pure)																			
Period	CA-RW-01R	CA-RW-02R	CA-RW-03R	CA-RW-05R	CA-RW-06R	CA-RW-07B	CA-RW-08R	CA-RW-09R	CA-RW-10R	CA-RW-11R	CA-RW-12	CA-RW-14	CA-RW-15	CA-RW-17	CA-RW-18	CA-RW-19	CA-RW-20	Total Expanded System	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	1.0	1.0	0	0	0	0	0	1.4	0	0	0.3	0	0	0	0	0	3.7	3.7
February 2019	0	0	0	0	1.0	0	0	0	0	0	0	0	0	0	0.9	1.1	0	3.0	3.2
March 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.5
April 2019	0	0.9	0	0	0	0	0	0	1.1	0	0	0	0	0	0	0	0	2.0	2.2
May 2019	0	0	0	0	0	0	1.1	1.1	0	0	0	0	0	0	0	0	0	2.2	2.2
June 2019	0	0	0.7	0	0	1.5	0	0	0	1.0	0	0	0	0	0	0	0.8	4.0	4.0
July 2019	0	0	0	0	1.0	0	0	0	0	0	0	0	0	0	0	1.0	0	2.0	2.1
August 2019	0	0	0	0	0	0	1.0	0	2.4	0	0	0	0	0	0	0	0	3.4	3.6
September 2019	0	0	0	0	0	0	0	0	0	3.1	0	0	0	0	0	0	2.4	5.5	5.5
October 2019	0	2.1	0	1.8	0	2.1	0	0	0	0	0	0	0	0	0	0	0	6.0	6.0
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0
December 2019	0	0	0	0	0	2.1	0	0	0	2.3	0	0	0	0	0	0	2.1	6.5	6.5
Fourth Quarter 2019 Subtotal	0	2	0	2	0	4	0	0	0	2	0	0	0	0	0	0	2	13	13
Total Project to Date	60.1	45.4	31.3	34.3	35.9	29.1	24.1	25.5	21.8	28.0	0	5.8	17.9	11.9	25.6	47.5	32.5	476.6	553.2

Table 3-3
Summary of Discharges to Groundwater, Central Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

NuWell 310 (pure)													
Period	CA-RW-01	CA-RW-02	CA-RW-03	CA-RW-04	CA-RW-05	CA-RW-06	CA-RW-07R	CA-RW-08	CA-RW-09	CA-RW-10	CA-RW-11	CA-RW-12	Total
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
February 2019	0.1	0	0	0	0	0	0	0	0	0	0	0	0.1
March 2019	0	0	0	0	0.2	0	0.6	0	0	0	0	0	0.8
April 2019	0	0	0	0	0	0.1	0	0	0	0	0	0	0.1
May 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
June 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
July 2019	0	0	0	0	0.1	0	0	0	0	0	0	0	0.1
August 2019	0	0	0	0	0	0.1	0	0	0	0	0	0	0.1
September 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
October 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Project to Date	1.9	0	1.8	0	1.2	9.0	19.5	0	0	0	0	0	33.4

NuWell 310 (pure)																			
Period	CA-RW-01R	CA-RW-02R	CA-RW-03R	CA-RW-05R	CA-RW-06R	CA-RW-07B	CA-RW-08R	CA-RW-09R	CA-RW-10R	CA-RW-11R	CA-RW-12	CA-RW-14	CA-RW-15	CA-RW-17	CA-RW-18	CA-RW-19	CA-RW-20	Total Expanded System	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0.5	0.5	0	0	0	0	0	0.7	0	0	0.1	0	0	0	0	0	1.8	1.8
February 2019	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0.5	0.6	0	1.6	1.7
March 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.8
April 2019	0	0.5	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	1.0	1.1
May 2019	0	0	0	0	0	0	0.5	0.6	0	0	0	0	0	0	0	0	0	1.1	1.1
June 2019	0	0	0.4	0	0	0.8	0	0	0	0.5	0	0	0	0	0	0	0.4	2.1	2.1
July 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0.5	0.6
August 2019	0	0	0	0	0	0	0.5	0	0.9	0	0	0	0	0	0	0	0	1.4	1.5
September 2019	0	0	0	0	0	0	0	0	0	1.2	0	0	0	0	0	0	1.0	2.2	2.2
October 2019	0	0.8	0	0.7	0	0.8	0	0	0	0	0	0	0	0	0	0	0	2.3	2.3
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0
December 2019	0	0	0	0	0	0.8	0	0	0	0.9	0	0	0	0	0	0	0.8	2.5	2.5
Fourth Quarter 2019 Subtotal	0	1	0	1	0	2	0	0	0	1	0	0	0	0	0	0	1	5	5
Total Project to Date	32.6	22.8	16.0	17.3	17.8	14.9	12.9	13.2	10.4	13.6	0	2.7	8.4	6.1	13.0	20.6	19.7	242.1	275.5

Note:
% = percent
a = Totalizer volumes at CA-RW-09 from January 2015 through September 2016 are representative of recirculated groundwater for the bioreactor and are excluded from Central Area total volumes.

Table 3-7
Summary of Extraction Volumes, Northwest Area Extraction Wells for South Central Reinjection Area
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Extraction Well	Operating Period	Extraction Volume and Rate				Average Extraction Rate (gpm) for Period ⁴
		Extraction Volume (gallons)	Total Days in Period Pumping	% of Period Actively Pumping	Average Extraction Rate (gpm) when Pumping ³	
EX-05	Jan-2019	0	0	0	0	0
	Feb-2019	0	0	0	0	0
	Mar-2019	0	0	0	0	0
	Apr-2019	0	0	0	0	0
	May-2019	0	0	0	0	0
	June-2019	0	0	0	0	0
	July-2019	0	0	0	0	0
	Aug-2019	0	0	0	0	0
	Sep-2019	0	0	0	0	0
	Oct-2019	0	0	0	0	0
	Nov-2019	0	0	0	0	0
	Dec-2019	0	0	0	0	0
EX-15	Jan-2019	0	0	0	0	0
	Feb-2019	0	0	0	0	0
	Mar-2019	0	0	0	0	0
	Apr-2019	12390	1	4	8	0
	May-2019	0	0	0	0	0
	June-2019	0	0	0	0	0
	July-2019	0	0	0	0	0
	Aug-2019	0	0	0	0	0
	Sep-2019	0	0	0	0	0
	Oct-2019	24,720	2	7	8	1
	Nov-2019	0	0	0	0	0
	Dec-2019	0	0	0	0	0
EX-16	Jan-2019	0	0	0	0	0
	Feb-2019	0	0	0	0	0
	Mar-2019	48	0	0	4	0
	Apr-2019	18,488	1	3	16	0
	May-2019	0	0	0	0	0
	June-2019	920	0	1	2	0
	July-2019	0	0	0	0	0
	Aug- 2019	0	0	0	0	0
	Sep-2019	0	0	0	0	0
	Oct-2019	0	0	0	0	0
	Nov-2019	0	0	0	0	0
	Dec-2019	0	0	0	0	0
EX-20	Jan-2019	0	0	0	0	0
	Feb-2019	0	0	0	0	0
	Mar-2019	0	0	0	0	0
	Apr-2019	8,750	2	6	3	0
	May-2019	0	0	0	0	0
	June-2019	0	0	0	0	0
	July-2019	0	0	0	0	0
	Aug-2019	0	0	0	0	0
	Sep-2019	0	0	0	0	0
	Oct-2019	15,070	2	7	5	0
	Nov-2019	0	0	0	0	0
	Dec-2019	0	0	0	0	0

Table 3-7
Summary of Extraction Volumes, Northwest Area Extraction Wells for South Central Reinjection Area
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Extraction Well	Operating Period	Extraction Volume and Rate				Average Extraction Rate (gpm) for Period ⁴
		Extraction Volume (gallons)	Total Days in Period Pumping	% of Period Actively Pumping	Average Extraction Rate (gpm) when Pumping ³	
EX-21	Jan-2019	0	0	0	0	0
	Feb-2019	0	0	0	0	0
	Mar-2019	0	0	0	0	0
	Apr-2019	110	0	0	6	0
	May-2019	0	0	0	0	0
	June-2019	140	0	0	6	0
	July-2019	0	0	0	0	0
	Aug-2019	0	0	0	0	0
	Sep-2019	0	0	0	0	0
	Oct-2019	0	0	0	0	0
	Nov-2019	0	0	0	0	0
	Dec-2019	0	0	0	0	0
EX-22	Jan-2019	552,330	31	100	12	12
	Feb-2019	498,800	28	100	12	12
	Mar-2019	545,560	31	99	12	12
	Apr-2019	522,400	29	96	13	12
	May-2019	390,400	22	70	12	9
	June-2019	497,229	28	94	12	12
	July-2019	553,170	31	100	12	12
	Aug-2019	450,820	25	80	13	10
	Sep-2019	533,720	30	100	12	12
	Oct-2019	548,170	31	99	12	12
	Nov-2019	489,140	27	91	12	11
	Dec-2019	522,600	28	95	13	12
EX-29	Jan-2019	0	0	0	0	0
	Feb-2019	0	0	0	0	0
	Mar-2019	0	0	0	0	0
	Apr-2019	0	0	0	0	0
	May-2019	0	0	0	0	0
	June-2019	0	0	0	0	0
	July-2019	0	0	0	0	0
	Aug-2019	0	0	0	0	0
	Sep-2019	0	0	0	0	0
	Oct-2019	0	0	0	0	0
	Nov-2019	0	0	0	0	0
	Dec-2019	0	0	0	0	0
EX-30	Jan-2019	0	0	0	0	0
	Feb-2019	0	0	0	0	0
	Mar-2019	0	0	0	0	0
	Apr-2019	0	0	0	0	0
	May-2019	0	0	0	0	0
	June-2019	0	0	0	0	0
	July-2019	0	0	0	0	0
	Aug-2019	0	0	0	0	0
	Sep-2019	0	0	0	0	0
	Oct-2019	0	0	0	0	0
	Nov-2019	0	0	0	0	0
	Dec-2019	0	0	0	0	0

Table 3-7

Summary of Extraction Volumes, Northwest Area Extraction Wells for South Central Reinjection Area
 Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
 Northwest Freshwater Injection Projects
 Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Extraction Well	Operating Period	Extraction Volume and Rate				Average Extraction Rate (gpm) for Period ⁴
		Extraction Volume (gallons)	Total Days in Period Pumping	% of Period Actively Pumping	Average Extraction Rate (gpm) when Pumping ³	
Diversion from Northern ATU Wells*	Jan-2019	3,303,190			74	74
	Feb-2019	4,235,248			105	105
	Mar-2019	5,276,440			118	118
	Apr-2019	8,194,854			190	190
	May-2019	9,238,336			207	207
	June-2019	8,997,103			208	208
	July-2019	9,146,510			205	205
	Aug-2019	9,129,948			205	205
	Sep-2019	8,850,792			205	205
	Oct-2019	8,914,408			200	200
	Nov-2019	8,400,096			194	194
	Dec-2019	8,467,256			190	190
Totals and Averages:						
Fourth Quarter 2019		27,871,060				
Annual (Jan 2019 to Dec 2019)		98,339,156			201	187
Total Volume to Date		522,039,997				
Average Monthly	Jan-2019					86
	Feb-2019					117
	Mar-2019					130
	Apr-2019					203
	May-2019					216
	June-2019					220
	July-2019					217
	Aug-2019					215
	Sep-2019					217
	Oct-2019					213
	Nov-2019					206
	Dec-2019					202
Combined Extraction Rate for EX-15, EX-16 and EX-20	Jan-2019					0
	Feb-2019					0
	Mar-2019					0
	Apr-2019					1
	May-2019					0
	June-2019					0
	July-2019					0
	Aug-2019					0
	Sep-2019					0
	Oct-2019					1
	Nov-2019					0
	Dec-2019					0

Table 3-7

**Summary of Extraction Volumes, Northwest Area Extraction Wells for South Central ReInjection Area
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California**

Notes:

1. Extraction from Northwest Area extraction well system for South Central ReInjection Area reinjection commenced on October 20, 2009.
 2. On January 12, 2015, EX-29 and EX-30 were routed to the Ranch pivot and diversion to the South Central ReInjection Area was discontinued.
 3. Average extraction rates (when pumping) in gpm for individual wells calculated from monthly volume and total days operating.
 4. Average extraction rates (for period) (gpm) for individual wells calculated from monthly volume and total calendar days in month.
 5. Annual average extraction rate calculated from annual volume and 365 days in January 2019 to December 2019.
- * = Water from northern ATU extraction wells was diverted to the Central Area and South Central ReInjection Area systems periodically starting in Second Quarter 2015. The remaining portion of the water from northern ATU wells supplies the northern ATUs.

% = percent

ATU = agricultural treatment unit

gpm = gallons per minute

Table 3-8
Summary of Discharges to Groundwater, South Central Reinjection Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Recirculated Groundwater (Original System and 2015 Expansion)																				
Period	SC-IW-10	SC-IW-11	SC-IW-12	SC-IW-13	SC-IW-14	SC-IW-15	SC-IW-21	SC-IW-22	SC-IW-23	SC-IW-24	SC-IW-25	SC-IW-26	SC-IW-32	SC-IW-33	SC-IW-34	SC-IW-35	SC-IW-36	SC-IW-37	Infiltration Gallery	Original and 2015 Expansion
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	635,195	0	0	0	202,738	0	0	0	386,453	0	0	0	0	0	0	17	0	1,224,403
February 2019	232,620	0	939,479	0	0	0	133,149	0	0	0	169,867	0	0	0	0	0	0	808,457	0	2,283,572
March 2019	1,073,963	0	470,900	0	0	0	118,103	0	0	0	169,941	0	0	0	0	0	0	557,251	0	2,390,158
April 2019	865,562	0	467,009	0	0	0	52,415	0	0	0	196,645	0	0	0	156,217	0	0	260,102	0	1,997,950
May 2019	653,400	0	96,030	0	0	0	28,389	0	0	0	1,634	0	0	0	344,736	0	0	335,112	0	1,459,301
June 2019	0	0	708,351	0	0	0	110,388	0	0	0	658,115	0	0	0	271,144	0	0	433,179	0	2,181,177
July 2019	958,878	0	496,175	0	0	0	112,338	0	0	0	496,172	0	0	0	198,667	0	0	266,819	0	2,529,050
August 2019	1,047,974	0	356,279	0	0	0	63,243	0	0	0	251,153	0	0	0	173,588	0	0	0	0	1,892,236
September 2019	1,047,400	0	356,279	0	0	0	37,350	0	0	0	7,060	0	0	0	167,362	0	2,824	0	0	1,618,275
October 2019	537,902	0	0	0	0	0	34,961	0	0	0	1,221,595	0	0	0	139,787	0	562,307	0	0	2,496,552
November 2019	727,551	0	0	0	0	0	51,953	0	0	0	475,703	0	0	0	0	0	79,663	0	0	1,334,870
December 2019	1,210,741	0	0	0	0	0	0	0	0	0	407,075	0	0	0	0	0	0	0	0	1,617,816
Fourth Quarter 2019 Subtotal	2,476,194	0	0	0	0	0	86,914	0	0	0	2,104,373	0	0	0	139,787	0	641,970	0	0	5,449,238
Total Project to Date	23,615,104	8,625,023	15,598,442	3,983,870	1,814,488	3,842,326	7,819,475	14,005,308	41,471,147	27,780,055	18,212,486	23,900,911	10,285,461	13,052,777	38,508,482	14,038,648	21,376,093	15,010,860	499,659	303,440,614

Recirculated Groundwater (2017 and Western Expansions)																	
Period	SC-IW-16	SC-IW-17	SC-IW-18	SC-IW-19	SC-IW-20	SC-IW-30	SC-IW-31	SC-IW-38	SC-IW-39	SC-IW-40	SC-IW-41	SC-IW-42	SC-IW-43	SC-IW-44	SC-IW-45	SC-IW-46	2017 and Western Expansion
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	4	0	494,167	79,741	164,902	119,329	157,419	167,467	0	0	868,892	0	371,121	469,122	0	258,504	3,150,668
February 2019	150,365	0	237,827	20,304	165,046	49,104	167,482	111,515	0	0	630,276	0	220,904	371,765	0	144,308	2,268,896
March 2019	84,891	0	782,256	86,250	196,189	0	205,817	52,875	0	0	399,354	100,821	118,293	319,586	0	48,717	2,395,050
April 2019	71,223	0	223,410	29,011	62,808	105,749	251,544	371,485	0	0	321,124	148,152	467,462	388,842	0	169,754	2,610,563
May 2019	106,792	0	479,012	89,029	0	252,932	204,593	311,093	0	0	984,047	0	348,216	312,363	0	320,421	3,408,498
June 2019	31,878	0	157,479	120,238	38,906	123,096	85,529	112,961	0	0	591,731	0	194,637	184,330	0	181,664	1,822,449
July 2019	76,560	0	438,921	111,126	440,654	84,768	396,503	0	0	0	260,226	200,486	73,090	128,050	75,970	59,467	2,345,821
August 2019	0	0	0	31,752	255,142	97,230	261,828	0	0	0	0	1,031,180	0	0	983,874	0	2,661,005
September 2019	0	0	0	0	454,644	62,287	149,094	0	0	0	0	606,743	0	0	465,943	0	1,738,711
October 2019	0	0	0	66,874	140,666	124,977	99,342	0	0	0	0	189,543	0	0	145,636	0	767,038
November 2019	0	0	0	49,759	84,542	257,043	8,717	0	0	0	0	459,877	0	0	16,004	0	875,943
December 2019	0	0	0	44,314	101,442	134,488	0	0	0	0	0	507,125	0	0	732,986	0	1,520,355
Fourth Quarter 2019 Subtotal	0	0	0	160,947	326,651	516,508	108,059	0	0	0	0	1,156,545	0	0	894,625	0	3,163,335
Total Project to Date	1,768,870	12,035,916	10,584,801	3,514,560	11,238,271	5,622,002	4,326,734	2,402,497	7,595,840	0	4,155,938	7,475,874	3,880,930	2,384,953	7,047,423	2,479,000	86,513,609

Table 3-8
Summary of Discharges to Groundwater, South Central Reinjection Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Recirculated Groundwater (2019 SCRIA East Expansion)									
Period	EX-57	EX-58	SC-IW-60	SC-IW-61	SC-IW-62	SC-IW-63	SC-IW-64	Deep East SCRIA Expansion	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	--	--	--	--	--	--	--	--	4,375,071
February 2019	--	--	--	--	--	--	--	--	4,552,468
March 2019	--	--	--	--	--	--	--	--	4,785,209
April 2019	0	40,451	0	0	71,256	0	0	111,707	4,720,219
May 2019	0	172,049	0	0	302,549	637,695	281,903	1,394,196	6,261,995
June 2019	0	284,577	0	0	477,562	775,451	119,997	1,657,587	5,661,213
July 2019	0	281,863	0	0	298,058	664,133	0	1,244,054	6,118,925
August 2019	0	431,175	0	0	312,111	832,418	0	1,575,704	6,128,946
September 2019	0	1,146,636	0	0	753,946	918,153	0	2,818,736	6,175,722
October 2019	0	906,333	0	0	676,951	1,204,778	0	2,788,062	6,051,652
November 2019	0	745,074	0	0	507,796	1,571,713	0	2,824,582	5,035,395
December 2019	469,522	790,334	0	0	65,081	1,386,948	0	2,711,885	5,850,056
Fourth Quarter 2019 Subtotal	469,522	2,441,741	0	0	1,249,828	4,163,439	0	8,324,529	16,937,103
Total Project to Date	469,522	4,798,493	0	0	3,465,310	7,991,289	401,900	17,126,514	407,080,736

95% Ethanol (Original System and 2015 Expansion)																				
Period	SC-IW-10	SC-IW-11	SC-IW-12	SC-IW-13	SC-IW-14	SC-IW-15	SC-IW-21	SC-IW-22	SC-IW-23	SC-IW-24	SC-IW-25	SC-IW-26	SC-IW-32	SC-IW-33	SC-IW-34	SC-IW-35	SC-IW-36	SC-IW-37	Infiltration Gallery	Original and 2015 Expansion
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	215	0	0	0	51	0	0	0	91	0	0	0	0	0	0	22	0	379
February 2019	84	0	214	0	0	0	35	0	0	0	42	0	0	0	0	0	0	218	0	593
March 2019	217	0	93	0	0	0	24	0	0	0	29	0	0	0	0	0	0	109	0	472
April 2019	201	0	133	0	0	0	17	0	0	0	45	0	0	0	37	0	0	66	0	500
May 2019	162	0	20	0	0	0	7	0	0	0	8	0	0	0	74	0	0	91	0	362
June 2019	0	0	191	0	0	0	28	0	0	0	162	0	0	0	66	0	0	93	0	540
July 2019	193	0	147	0	0	0	26	0	0	0	129	0	0	0	54	0	0	65	0	614
August 2019	321	0	94	0	0	0	19	0	0	0	63	0	0	0	50	0	0	0	0	547
September 2019	254	0	0	0	0	0	8	0	0	0	0	0	0	0	35	0	0	0	0	297
October 2019	116	0	0	0	0	0	15	0	0	0	311	0	0	0	29	0	157	0	0	628
November 2019	224	0	0	0	0	0	13	0	0	0	120	0	0	0	0	0	0	0	0	357
December 2019	353	0	0	0	0	0	0	0	0	0	115	0	0	0	0	0	0	0	0	468
Fourth Quarter 2019 Subtotal	692	0	0	0	0	0	28	0	0	0	547	0	0	0	29	0	157	0	0	1,453
Total Project to Date	4,281	1,238	3,150	487	227	486	1,229	1,978	5,480	5,015	3,311	4,778	1,619	1,800	6,290	2,136	3,563	2,466	195	50,218

Table 3-8
Summary of Discharges to Groundwater, South Central Reinjection Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

95% Ethanol (2017 and Western Expansions)																	
Period	SC-IW-16	SC-IW-17	SC-IW-18	SC-IW-19	SC-IW-20	SC-IW-30	SC-IW-31	SC-IW-38	SC-IW-39	SC-IW-40	SC-IW-41	SC-IW-42	SC-IW-43	SC-IW-44	SC-IW-45	SC-IW-46	2017 and Western Expansion
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	7	0	120	16	37	22	36	38	0	0	225	0	94	121	0	61	777
February 2019	36	0	78	10	41	16	41	26	0	0	149	0	52	88	0	39	576
March 2019	16	0	137	22	41	0	41	10	0	0	74	28	23	67	0	10	471
April 2019	18	0	65	9	18	23	55	89	0	0	94	73	117	110	0	29	699
May 2019	27	0	105	23	0	57	39	68	0	0	249	0	87	87	0	76	820
June 2019	8	0	39	32	8	28	21	26	0	0	134	0	41	44	0	42	424
July 2019	22	0	116	31	121	24	114	6	0	0	67	43	24	39	22	19	647
August 2019	0	0	0	10	76	27	75	0	0	0	0	297	0	0	304	0	789
September 2019	0	0	0	0	111	10	31	0	0	0	0	121	0	0	110	0	382
October 2019	0	0	0	34	40	54	24	0	0	0	0	41	0	0	40	0	234
November 2019	0	0	0	19	33	57	0	0	0	0	0	137	0	0	0	0	245
December 2019	0	0	0	13	26	43	0	0	0	0	0	140	0	0	225	0	447
Fourth Quarter 2019 Subtotal	0	0	0	66	99	154	24	0	0	0	0	318	0	0	265	0	927
Total Project to Date	331	1,976	2,137	722	2,366	1,204	1,036	509	1,465	0	995	1,669	998	627	1,603	589	18,228

95% Ethanol (2019 SCRIA East Expansion)									
Period	EX-57	EX-58	SC-IW-60	SC-IW-61	SC-IW-62	SC-IW-63	SC-IW-64	Deep East SCRIA Expansion	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	--	--	--	--	--	--	--	--	1,155
February 2019	--	--	--	--	--	--	--	--	1,169
March 2019	--	--	--	--	--	--	--	--	942
April 2019	0	17	0	0	16	0	0	33	1,231
May 2019	0	40	0	0	73	142	69	324	1,506
June 2019	0	73	0	0	112	171	22	379	1,343
July 2019	0	77	0	0	85	124	0	285	1,547
August 2019	0	148	0	0	117	232	0	496	1,832
September 2019	0	275	0	0	176	221	0	672	1,351
October 2019	0	227	0	0	168	330	0	725	1,587
November 2019	0	198	0	0	126	388	0	712	1,314
December 2019	156	253	0	0	31	412	0	852	1,767
Fourth Quarter 2019 Subtotal	156	678	0	0	325	1,129	0	2,289	4,668
Total Project to Date	156	1,307	0	0	904	2,019	91	4,477	72,924

Table 3-8
Summary of Discharges to Groundwater, South Central Reinjection Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Eosine																				
Period	SC-IW-10	SC-IW-11	SC-IW-12	SC-IW-13	SC-IW-14	SC-IW-15	SC-IW-21	SC-IW-22	SC-IW-23	SC-IW-24	SC-IW-25	SC-IW-26	SC-IW-32	SC-IW-33	SC-IW-34	SC-IW-35	SC-IW-36	SC-IW-37	Infiltration Gallery and Direct-Push Pilot	Direct-Push Pilot
	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)
January 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
February 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
March 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
April 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
May 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
June 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
July 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
August 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
September 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
October 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Project to Date	0	0	0	0	0	0	0	3.3	0	5.9	0	5.3	4.2	2.0	5.0	0	5.0	0	0.3	4.2

Bromide (500 ppm concentration)			
Period	SC-MW-02D	SC-MW-03D	Total Monthly Volume (gallons)
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	
January 2019	0	0	0
February 2019	0	0	0
March 2019	0	0	0
April 2019	0	0	0
May 2019	0	0	0
June 2019	0	0	0
July 2019	0	0	0
August 2019	0	0	0
September 2019	0	0	0
October 2019	0	0	0
November 2019	0	0	0
December 2019	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0
Total Project to Date	4	4	8

Table 3-8
Summary of Discharges to Groundwater, South Central Reinjection Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
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Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

60% Sodium Lactate																				
Period	SC-IW-10	SC-IW-11	SC-IW-12	SC-IW-13	SC-IW-14	SC-IW-15	SC-IW-21	SC-IW-22	SC-IW-23	SC-IW-24	SC-IW-25	SC-IW-26	SC-IW-32	SC-IW-33	SC-IW-34	SC-IW-35	SC-IW-36	SC-IW-37	Infiltration Gallery	Total Monthly Volume (gallons)
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	
January 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
February 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
March 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
April 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
May 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
June 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
July 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
August 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
September 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
October 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Project to Date	0	0	0	0	0	0	0	50	0	95	93	0	0	0	99	98	118	0	4	556

NuWell 120 (pure) - Original System and 2015 Expansion																				
Period	SC-IW-10	SC-IW-11	SC-IW-12	SC-IW-13	SC-IW-14	SC-IW-15	SC-IW-21	SC-IW-22	SC-IW-23	SC-IW-24	SC-IW-25	SC-IW-26	SC-IW-32	SC-IW-33	SC-IW-34	SC-IW-35	SC-IW-36	SC-IW-37	Infiltration Gallery	Original and 2015 Expansion
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	0	0	0	0	0	0	0	0	0	1.2	0	0	0	0	0	0	0	1.2
February 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
March 2019	0	0	0	0	0	0	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0.8
April 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.1	0	1.1
May 2019	0	0	1.4	0	0	0	0	0	0	0	1.4	0	0	0	0	0	0	0	0	2.8
June 2019	1.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.3
July 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
August 2019	0	0	2.9	0	0	0	0	0	0	0	2.7	0	0	0	0	0	0	0	0	5.6
September 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.5	0	2.5
October 2019	3.0	0	0	0	0	0	4.4	0	0	0	0	0	0	0	2.6	0	0	0	0	10.0
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Fourth Quarter 2019 Subtotal	3	0	0	0	0	0	4	0	0	0	0	0	0	0	3	0	0	0	0	10
Total Project to Date	36.2	31.6	39.0	26.1	10.9	14.7	9.0	0	20.2	45.0	14.3	54.1	0	10.1	22.3	8.1	16.7	27.6	0	385.8

Table 3-8
Summary of Discharges to Groundwater, South Central Reinjection Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

NuWell 120 (pure) - 2017 and Western Expansions																	
Period	SC-IW-16	SC-IW-17	SC-IW-18	SC-IW-19	SC-IW-20	SC-IW-30	SC-IW-31	SC-IW-38	SC-IW-39	SC-IW-40	SC-IW-41	SC-IW-42	SC-IW-43	SC-IW-44	SC-IW-45	SC-IW-46	2017 and Western Expansions
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
February 2019	0	0	1.0	0.4	0.8	0.8	0	0	0	0	0	0	0	0	0	0	3.0
March 2019	0	0	0	0	0	0	0.7	0	0	0	0	0	0	0	0	0	0.7
April 2019	0	0	0	0	0	0	0	0	0	0	0.8	0	0	1.1	0	1.2	3.1
May 2019	0	0	0	0.4	0.7	0	0	0	0	0	0	0	0	0	0	0	1.1
June 2019	0.5	0	0.9	0	0	0	0.7	0	0	0	0	0	0	0	0	0	2.1
July 2019	0	0	0	0	0	0	0	0.7	0	0	0	0.8	0.5	0	0	0	2.0
August 2019	0	0	0	2.1	0	0	0	0	0	0	0.7	0	0	0	0	0	2.8
September 2019	0	0	0	0	3.8	6.8	0	0	0	0	0	0	0	0	0	0	10.6
October 2019	0	0	0	0	0	0	3.6	0	0	0	1.6	2.6	0	1.0	2.3	0	11.1
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.1	1.1
December 2019	0	0	0	0	3.2	0	0	0	0	0	0	0	0	0	0	0	3.2
Fourth Quarter 2019 Subtotal	0	0	0	0	3	0	4	0	0	0	2	3	0	1	2	1	15
Total Project to Date	3.8	5.4	3.6	11.3	12.8	16.5	6.3	2.1	9.0	0	3.1	7.4	1.7	2.1	4.7	2.8	92.6

NuWell 120 (pure) - 2019 SCRIA East Expansion									
Period	EX-57	EX-58	SC-IW-60	SC-IW-61	SC-IW-62	SC-IW-63	SC-IW-64	Deep East SCRIA Expansion	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	--	--	--	--	--	--	--	--	1.2
February 2019	--	--	--	--	--	--	--	--	3.0
March 2019	--	--	--	--	--	--	--	--	1.5
April 2019	--	--	--	--	--	--	--	--	4.2
May 2019	--	--	--	--	--	--	--	--	3.9
June 2019	--	--	--	--	--	--	--	--	3.4
July 2019	0	0.9	0	0	0	0	0	0.9	2.9
August 2019	0	0	0	0	1.0	0	0	1.0	9.4
September 2019	0	0	0	0	0	0	0	0.0	13.1
October 2019	0	0	0	0	0	0	0	0.0	21.1
November 2019	0	0	0	0	0	2.1	0	2.1	3.2
December 2019	0	0	0	0	2	0	0	2.3	5.5
Fourth Quarter 2019 Subtotal	0	0	0	0	2	2	0	4	30
Total Project to Date	0	0.9	0	0	3.3	2	0	6.3	429.5

Table 3-8
Summary of Discharges to Groundwater, South Central Reinjection Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

NuWell 310 (pure) - Original System and 2015 Expansion																				
Period	SC-IW-10	SC-IW-11	SC-IW-12	SC-IW-13	SC-IW-14	SC-IW-15	SC-IW-21	SC-IW-22	SC-IW-23	SC-IW-24	SC-IW-25	SC-IW-26	SC-IW-32	SC-IW-33	SC-IW-34	SC-IW-35	SC-IW-36	SC-IW-37	Infiltration Gallery	Total Monthly Volume (gallons)
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	
January 2019	0	0	0	0	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0.6
February 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
March 2019	0	0	0	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0.4
April 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.6	0	0.6
May 2019	0	0	0.7	0	0	0	0	0	0	0	0.7	0	0	0	0	0	0	0	0	1.4
June 2019	0.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.7
July 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
August 2019	0	0	1.1	0	0	0	0	0	0	0	1.0	0	0	0	0	0	0	0	0	2.1
September 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.0	0	1.0
October 2019	1.1	0	0	0	0	0	1.7	0	0	0	0	0	0	0	1.0	0	0	0	0	3.8
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	1	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	4
Total Project to Date	18.0	16.2	19.5	13.4	5.6	7.4	4.1	0.0	10.8	27.1	6.9	27.7	0.0	3.9	10.5	4.1	8.6	13.9	0.0	197.7

NuWell 310 (pure) - 2017 and Western Expansions																	
Period	SC-IW-16	SC-IW-17	SC-IW-18	SC-IW-19	SC-IW-20	SC-IW-30	SC-IW-31	SC-IW-38	SC-IW-39	SC-IW-40	SC-IW-41	SC-IW-42	SC-IW-43	SC-IW-44	SC-IW-45	SC-IW-46	Western Expansion
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0
February 2019	0	0	0.5	0.2	0.4	0.4	0	0	0	0	0	0	0	0	0	0	1.5
March 2019	0	0	0	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0.4
April 2019	0	0	0	0	0	0	0	0	0	0	0.4	0	0	0.6	0	0.6	1.6
May 2019	0	0	0	0.2	0.4	0	0	0	0	0	0	0	0	0	0	0	0.6
June 2019	0.3	0	0.4	0	0	0	0.4	0	0	0	0	0	0	0	0	0	1.1
July 2019	0	0	0	0	0	0	0	0.3	0	0	0	0.4	0.2	0	0	0	0.9
August 2019	0	0	0	0.8	0	0	0	0	0	0	0.4	0	0	0	0	0	1.2
September 2019	0	0	0	0	1.5	2.6	0	0	0	0	0	0	0	0	0	0	4.1
October 2019	0	0	0	0	0	0	1.4	0	0	0	0.6	1.0	0	0.4	0.9	0	4.3
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4	0.4
December 2019	0	0	0	0	1.2	0	0	0	0	0	0	0	0	0	0	0	1.2
Fourth Quarter 2019 Subtotal	0	0	0	0	1	0	1	0	0	0	1	1	0	0	1	0	6
Total Project to Date	2.0	2.8	1.8	5.5	5.7	7.6	2.9	1.0	4.5	0.0	1.4	4.4	0.8	1.0	2.1	1.3	44.8

Table 3-8
Summary of Discharges to Groundwater, South Central Reinjection Area In Situ Reactive Zone
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Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

NuWell 310 (pure) - 2019 Deep SCRIA East Expansion									
Period	EX-57	EX-58	SC-IW-60	SC-IW-61	SC-IW-62	SC-IW-63	SC-IW-64	Deep East SCRIA Expansion	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	--	--	--	--	--	--	--	--	0.6
February 2019	--	--	--	--	--	--	--	--	1.5
March 2019	--	--	--	--	--	--	--	--	0.8
April 2019	--	--	--	--	--	--	--	--	2.2
May 2019	--	--	--	--	--	--	--	--	2.0
June 2019	--	--	--	--	--	--	--	--	1.8
July 2019	0	0.4	0	0	0	0	0	0.4	1.3
August 2019	0	0	0	0	0.5	0	0	0.5	3.8
September 2019	0	0	0	0	0	0	0	0.0	5.1
October 2019	0	0	0	0	0	0.8	0	0.8	8.9
November 2019	0	0	0	0	0	0	0	0.0	0.4
December 2019	0	0	0	0	1	0	0	0.9	2.1
Fourth Quarter 2019 Subtotal	0	0	0	0	1	1	0	2	11
Total Project to Date	0	0.4	0	0	1.4	1	0	2.6	245.1

Mud Nox, Well Development Compound (pure) ^a										
Period	SC-IW-16	SC-IW-17	SC-IW-18	SC-IW-19	SC-IW-20	SC-IW-30	SC-IW-31	SC-IW-38	SC-IW-39	Total Monthly Volume (gallons)
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	
January 2019	0	0	0	0	0	0	0	0	0	0
February 2019	0	0	0	0	0	0	0	0	0	0
March 2019	0	0	0	0	0	0	0	0	0	0
April 2019	0	0	0	0	0	0	0	0	0	0
May 2019	0	0	0	0	0	0	0	0	0	0
June 2019	0	0	0	0	0	0	0	0	0	0
July 2019	0	0	0	0	0	0	0	0	0	0
August 2019	0	0	0	0	0	0	0	0	0	0
September 2019	0	0	0	0	0	0	0	0	0	0
October 2019	0	0	0	0	0	0	0	0	0	0
November 2019	0	0	0	0	0	0	0	0	0	0
December 2019	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0	0	0	0	0	0	0	0
Total Project to Date	1	0	0	2	0	0	0	0	0	3

Notes:
ppm = parts per million
% = percent
-- = not available; well was not installed.
a. Mud Nox was pumped from the well after use, and the waste water was containerized in drums, profiled, and then properly disposed of offsite.

Table 3-10
Summary of Discharges to Groundwater, Source Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Recirculated Groundwater- Original Injection System													
Period	SA-RW-05	SA-RW-06	SA-RW-07	SA-RW-08	SA-RW-09	SA-RW-10	SA-RW-11	SA-RW-12	SA-RW-13	SA-RW-14	SA-RW-15	SA-RW-16	Total Original System
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	3	0	0	0	0	0	0	0	0	0	0	0	3
February 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
March 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
April 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
May 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
June 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
July 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
August 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
September 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
October 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Project to Date	3,783,645	2,684,942	7,064,571	2,898,956	5,384,955	3,102,918	7,648,471	11,513,618	14,018,238	4,250,063	3,648,407	5,884,571	71,883,355

Recirculated Groundwater - 2011 Expanded Injection System											
Period	SA-RW-01	SA-RW-02	SA-RW-03	SA-RW-04	SA-RW-17	SA-RW-18	SA-RW-19	SA-RW-20	SA-RW-21	Total 2011 Expanded System	Total Original and 2011 Expanded System
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	72,817	0	0	0	59,404	0	0	132,221	132,224
February 2019	0	0	0	0	0	0	55,396	0	0	55,396	55,396
March 2019	0	0	32,044	0	0	0	31,547	0	0	63,591	63,591
April 2019	0	0	58,494	0	0	0	1,300	0	0	59,794	59,794
May 2019	0	0	44,056	0	0	0	0	0	0	44,056	44,056
June 2019	0	0	74,222	0	0	0	0	0	0	74,222	74,222
July 2019	0	0	1,806	0	0	0	110,054	0	0	111,860	111,860
August 2019	0	0	0	0	0	0	91,080	0	0	91,080	91,080
September 2019	0	0	64,703	0	0	0	76,547	0	0	141,250	141,250
October 2019	0	0	56,890	0	0	0	21,033	0	0	77,923	77,923
November 2019	0	0	33,815	0	0	0	0	0	0	33,815	33,815
December 2019	0	0	72,147	0	0	0	0	0	0	72,147	72,147
Fourth Quarter 2019 Subtotal	0	0	162,852	0	0	0	21,033	0	0	183,885	183,885
Total Project to Date	5,327,324	4,799,663	11,282,326	12,264,234	11,251,960	9,123,954	13,435,344	10,647,218	20,391,393	98,523,416	170,406,772

Table 3-10
Summary of Discharges to Groundwater, Source Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Recirculated Groundwater- 2015 Expansion Injection System															
Period	SA-RW-26	SA-RW-27	SA-RW-28	SA-RW-29	SA-RW-30	SA-RW-31	SA-RW-32	SA-RW-33	SA-RW-34	SA-RW-35	SA-RW-36	SA-RW-37	SA-RW-38	Total 2015 Expanded System	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	150,490	0	164,110	414,830	164,080	92,210	206,400	0	0	0	0	0	0	1,192,120	1,324,344
February 2019	107,200	243,250	44,580	259,130	101,100	36,520	0	0	0	0	0	0	0	791,780	847,176
March 2019	98,540	65,451	29,140	302,640	790,540	225,190	0	0	0	0	0	0	0	1,511,501	1,575,092
April 2019	185,160	114,110	551,500	195,780	601,480	45,310	346,190	0	0	0	0	0	0	2,039,530	2,099,324
May 2019	94,830	179,030	1,065,340	186,090	579,600	441,580	404,910	0	0	0	0	0	0	2,951,380	2,995,436
June 2019	106,990	44,040	864,740	182,140	469,000	146,450	150,660	0	0	0	0	0	0	1,964,020	2,038,242
July 2019	118,580	93,770	494,550	256,380	496,800	171,000	56,430	0	0	0	0	0	0	1,687,510	1,799,370
August 2019	143,470	80,170	863,580	123,230	333,160	336,430	0	0	0	0	0	0	0	1,880,040	1,971,119
September 2019	161,520	107,230	844,050	108,520	559,440	173,950	0	0	0	0	0	0	0	1,954,710	2,095,961
October 2019	81,580	86,700	747,530	28,670	546,580	142,510	729,340	0	0	0	0	0	0	2,362,910	2,440,833
November 2019	30,630	19,720	909,480	0	442,480	372,770	443,780	0	0	0	0	0	0	2,218,860	2,252,675
December 2019	132,300	166,680	876,010	0	600,870	206,480	206,980	0	0	0	0	0	0	2,189,320	2,261,467
Fourth Quarter 2019 Subtotal	244,510	273,100	2,533,020	28,670	1,589,930	721,760	1,380,100	0	0	0	0	0	0	6,771,090	6,954,975
Total Project to Date	2,467,540	2,321,221	9,432,772	6,074,870	8,047,680	3,628,420	4,423,970	0	0	0	0	0	0	119,918,301	290,325,073

Recirculated Groundwater- 2017 Expansion and Replacement Injection System														
Period	SA-RW-39	SA-RW-40	SA-RW-41	SA-RW-42	SA-RW-43 ^a	SA-RW-44 ^a	SA-RW-45 ^a	SA-RW-46	SA-RW-47	SA-RW-48	SA-RW-50	SA-RW-51	Total 2017 Expanded System	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	432,230	0	0	853,940	0	0	0	0	0	0	15,772	793,807	2,095,749	3,420,093
February 2019	411,950	10	1,740	520,460	0	0	0	0	0	0	42,140	595,409	1,571,709	2,418,885
March 2019	413,460	213,010	191,560	533,135	0	0	0	0	0	0	80,140	357,471	1,788,776	3,363,868
April 2019	0	1,526,920	494,710	0	0	0	0	0	0	0	3,613	262,401	2,287,644	4,386,968
May 2019	137,130	855,150	137,840	0	0	0	0	0	0	0	59,573	239,775	1,429,468	4,424,904
June 2019	0	708,880	206,560	0	0	0	0	0	0	0	19,703	517,209	1,452,352	3,490,594
July 2019	0	683,370	74,890	633,867	0	0	0	0	0	0	5,657	777,894	2,175,678	3,975,048
August 2019	0	812,560	0	840,129	0	0	0	0	0	0	27,771	327,819	2,008,279	3,979,398
September 2019	0	203,990	0	764,890	0	0	0	0	0	0	61,119	596,418	1,626,417	3,722,378
October 2019	131,390	0	0	377,620	0	0	0	0	0	0	51,790	869,631	1,430,431	3,871,264
November 2019	25,670	300,010	175,540	212,390	0	0	0	0	0	0	20,320	744,390	1,478,320	3,730,995
December 2019	0	159,900	672,520	0	0	0	0	0	0	0	202,790	592,832	1,628,042	3,889,509
Fourth Quarter 2019 Subtotal	157,060	459,910	848,060	590,010	0	0	0	0	0	0	274,900	2,206,853	4,536,793	11,491,768
Total Project to Date	4,551,410	10,832,230	3,825,250	13,077,326	2,324,119	2,617,244	921,891	407	380	250,013	1,188,298	8,085,911	47,674,479	337,999,552

Table 3-10
Summary of Discharges to Groundwater, Source Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Recirculated Groundwater- Western IRZ Expansion Injection System					
Period	SA-RW-54	SA-RW-55	SA-RW-56	Total Western IRZ Expansion System	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	95,120	198,270	556,620	850,010	4,270,103
February 2019	84,120	1,124,920	401,820	1,610,860	4,029,745
March 2019	0	1,037,800	0	1,037,800	4,401,668
April 2019	0	42,360	0	42,360	4,429,328
May 2019	0	0	0	0	4,424,904
June 2019	0	0	0	0	3,490,594
July 2019	0	0	0	0	3,975,048
August 2019	0	0	0	0	3,979,398
September 2019	0	0	0	0	3,722,378
October 2019	0	0	0	0	3,871,264
November 2019	0	0	0	0	3,730,995
December 2019	0	0	0	0	3,889,509
Fourth Quarter 2019 Subtotal	0	0	0	0	11,491,768
Total Project to Date	2,098,401	3,885,960	7,420,200	13,404,561	351,404,113

95% Ethanol - Original Injection System													
Period	SA-RW-05	SA-RW-06	SA-RW-07	SA-RW-08	SA-RW-09	SA-RW-10	SA-RW-11	SA-RW-12	SA-RW-13	SA-RW-14	SA-RW-15	SA-RW-16	Total
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Volume (gallons)
January 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
February 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
March 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
April 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
May 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
June 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
July 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
August 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
September 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
October 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Project to Date	264	533	677	608	530	687	1,425	4,321	3,505	1,615	1,445	2,576	18,186

Table 3-10
Summary of Discharges to Groundwater, Source Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

95% Ethanol - 2011 Expanded Injection System											
Period	SA-RW-01	SA-RW-02	SA-RW-03	SA-RW-04	SA-RW-17	SA-RW-18	SA-RW-19	SA-RW-20	SA-RW-21	Total 2011 Expanded System	Total Original and 2011 Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	16	0	0	0	12	0	0	29	29
February 2019	0	0	0	0	0	0	11	0	0	11	11
March 2019	0	0	9	0	0	0	7	0	0	15	15
April 2019	0	0	9	0	0	0	0	0	0	10	10
May 2019	0	0	12	0	0	0	0	0	0	12	12
June 2019	0	0	11	0	0	0	0	0	0	11	11
July 2019	0	0	0	0	0	0	22	0	0	22	22
August 2019	0	0	0	0	0	0	16	0	0	16	16
September 2019	0	0	12	0	0	0	13	0	0	25	25
October 2019	0	0	12	0	0	0	4	0	0	15	15
November 2019	0	0	10	0	0	0	0	0	0	10	10
December 2019	0	0	17	0	0	0	0	0	0	17	17
Fourth Quarter 2019 Subtotal	0	0	39	0	0	0	4	0	0	43	43
Total Project to Date	1,562	1,307	2,324	2,425	1,756	1,421	2,833	2,211	2,837	18,676	36,862

95% Ethanol - 2015 Expanded Injection System															
Period	SA-RW-26	SA-RW-27	SA-RW-28	SA-RW-29	SA-RW-30	SA-RW-31	SA-RW-32	SA-RW-33	SA-RW-34	SA-RW-35	SA-RW-36	SA-RW-37	SA-RW-38	Total 2015 Expanded System	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	23	0	27	69	23	16	31	0	0	0	0	0	0	190	218
February 2019	20	48	8	46	19	3	0	0	0	0	0	0	0	144	155
March 2019	15	14	3	52	152	39	0	0	0	0	0	0	0	276	291
April 2019	27	22	98	38	98	7	61	0	0	0	0	0	0	350	360
May 2019	20	37	240	43	103	102	86	0	0	0	0	0	0	632	644
June 2019	23	9	138	27	72	18	21	0	0	0	0	0	0	308	319
July 2019	18	21	84	46	105	32	13	0	0	0	0	0	0	318	340
August 2019	33	14	169	26	61	70	0	0	0	0	0	0	0	374	390
September 2019	27	23	144	19	111	29	0	0	0	0	0	0	0	353	378
October 2019	19	24	169	7	112	32	149	0	0	0	0	0	0	511	527
November 2019	5	3	169	0	72	84	76	0	0	0	0	0	0	409	419
December 2019	48	56	217	0	158	48	50	0	0	0	0	0	0	577	594
Fourth Quarter 2019 Subtotal	71	83	554	7	341	165	275	0	0	0	0	0	0	1,497	1,539
Total Project to Date	1,706	2,093	3,653	3,598	3,255	3,383	3,756	2,480	677	1,168	457	171	76	26,474	63,337

Table 3-10
Summary of Discharges to Groundwater, Source Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

95% Ethanol- 2017 Expansion and Replacement Injection System														
Period	SA-RW-39	SA-RW-40	SA-RW-41	SA-RW-42	SA-RW-43	SA-RW-44	SA-RW-45	SA-RW-46	SA-RW-47	SA-RW-48	SA-RW-50	SA-RW-51	Total 2017 Expanded System	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	75	0	0	145	0	0	0	0	0	0	4	161	385	603
February 2019	72	0	0	94	0	0	0	0	0	0	10	138	314	470
March 2019	73	43	22	103	0	0	0	0	0	0	25	71	337	628
April 2019	0	255	77	0	0	0	0	0	0	0	5	48	385	744
May 2019	12	220	27	0	0	0	0	0	0	0	45	59	363	1,006
June 2019	0	100	52	0	0	0	0	0	0	0	12	109	273	592
July 2019	0	131	29	117	0	0	0	0	0	0	10	176	463	802
August 2019	0	160	0	167	0	0	0	0	0	0	65	71	463	852
September 2019	0	35	0	137	0	0	0	0	0	0	33	132	336	715
October 2019	31	0	0	86	0	0	0	0	0	0	12	224	352	879
November 2019	0	69	0	89	0	0	0	0	0	0	2	167	327	745
December 2019	0	44	162	0	0	0	0	0	0	0	58	177	441	1,035
Fourth Quarter 2019 Subtotal	31	113	162	175	0	0	0	0	0	0	72	568	1,120	2,659
Total Project to Date	857	2,148	749	2,651	468	536	194	0	0	79	402	1,840	9,926	73,262

95% Ethanol - Western IRZ Expansion Injection System					
Period	SA-RW-54	SA-RW-55	SA-RW-56	Total Western IRZ Expansion System	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	17	29	95	140	744
February 2019	12	189	75	276	746
March 2019	0	189	0	189	817
April 2019	0	6	0	6	750
May 2019	0	0	0	0	1,006
June 2019	0	0	0	0	592
July 2019	0	0	0	0	802
August 2019	0	0	0	0	852
September 2019	0	0	0	0	715
October 2019	0	0	0	0	879
November 2019	0	0	0	0	745
December 2019	0	0	0	0	1,035
Fourth Quarter 2019 Subtotal	0	0	0	0	2,659
Total Project to Date	391	712	1,419	2,521	75,784

Table 3-10
Summary of Discharges to Groundwater, Source Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

60% Sodium Lactate - Original Injection System													
Period	SA-RW-05	SA-RW-06	SA-RW-07	SA-RW-08	SA-RW-09	SA-RW-10	SA-RW-11	SA-RW-12	SA-RW-13	SA-RW-14	SA-RW-15	SA-RW-16	Total Original System
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
February 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
March 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
April 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
May 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
June 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
July 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
August 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
September 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
October 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Project to Date	1,197	6	1,469	5	1,553	5	2,856	8	3,303	7	220	9	10,640

NuWell 120 (pure) - Original Injection System													
Period	SA-RW-05	SA-RW-06	SA-RW-07	SA-RW-08	SA-RW-09	SA-RW-10	SA-RW-11	SA-RW-12	SA-RW-13	SA-RW-14	SA-RW-15	SA-RW-16	Total Original System
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Volume (gallons)
January 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
February 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
March 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
April 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
May 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
June 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
July 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
August 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
September 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
October 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Project to Date	11	8	5	7	0	0	44	46	37	11	0	0	169

Table 3-10
Summary of Discharges to Groundwater, Source Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

NuWell 120 (pure) - 2011 Expanded Injection System											
Period	SA-RW-01	SA-RW-02	SA-RW-03	SA-RW-04	SA-RW-17	SA-RW-18	SA-RW-19	SA-RW-20	SA-RW-21	Total 2011 Expanded System	Total Original and 2011 Expanded System
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	1	0	0	0	0	0	0	1	1
February 2019	0	0	0	0	0	0	0	0	0	0	0
March 2019	0	0	0	0	0	0	0	0	0	0	0
April 2019	0	0	0	0	0	0	0	0	0	0	0
May 2019	0	0	0	0	0	0	0	0	0	0	0
June 2019	0	0	0	0	0	0	0	0	0	0	0
July 2019	0	0	0	0	0	0	0	0	0	0	0
August 2019	0	0	1	0	0	0	0	0	0	1	1
September 2019	0	0	0	0	0	0	0	0	0	0	0
October 2019	0	0	0	0	0	0	0	0	0	0	0
November 2019	0	0	2	0	0	0	3	0	0	5	5
December 2019	0	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	2	0	0	0	3	0	0	5	5
Total Project to Date	12	12	40	33	48	35	89	80	63	412	581

NuWell 120 (pure) - 2015 Expanded Injection System															
Period	SA-RW-26	SA-RW-27	SA-RW-28	SA-RW-29	SA-RW-30	SA-RW-31	SA-RW-32	SA-RW-33	SA-RW-34	SA-RW-35	SA-RW-36	SA-RW-37	SA-RW-38	Total 2015 Expanded System	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
February 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
March 2019	1	0	1	1	1	0	0	0	0	0	0	0	0	5	5
April 2019	0	0	0	0	0	2	0	0	0	0	0	0	0	2	2
May 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
June 2019	1	0	0	1	1	0	0	0	0	0	0	0	0	3	3
July 2019	0	1	1	0	0	0	1	0	0	0	0	0	0	4	4
August 2019	1	0	0	0	3	0	0	0	0	0	0	0	0	4	6
September 2019	0	5	0	0	0	0	0	0	0	0	0	0	0	5	5
October 2019	0	0	3	6	0	0	0	0	0	0	0	0	0	9	9
November 2019	0	0	0	0	0	3	0	0	0	0	0	0	0	3	9
December 2019	6	5	0	0	3	0	0	0	0	0	0	0	0	15	15
Fourth Quarter 2019 Subtotal	6	5	3	6	3	3	0	0	0	0	0	0	0	27	32
Total Project to Date	44	53	44	54	58	79	59	38	27	4	3	0	9	472	1,054

Table 3-10
Summary of Discharges to Groundwater, Source Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

NuWell 120 (pure) - 2017 Expansion Injection System														
Period	SA-RW-39	SA-RW-40	SA-RW-41	SA-RW-42	SA-RW-43	SA-RW-44	SA-RW-45	SA-RW-46	SA-RW-47	SA-RW-48	SA-RW-50	SA-RW-51	Total 2017 Expanded System	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	1	0	0	0	0	0	0	0	0	0	0	1	2
February 2019	0	0	0	0	0	0	0	0	0	0	1	0	1	1
March 2019	1	0	0	0	0	0	0	0	0	0	0	1	2	7
April 2019	0	0	0	0	0	0	0	0	0	0	1	0	1	2
May 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0
June 2019	0	1	1	0	0	0	0	0	0	0	0	1	3	6
July 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	4
August 2019	0	0	1	0	0	0	0	0	0	0	1	0	2	8
September 2019	0	3	0	0	0	0	0	0	0	0	0	3	5	10
October 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	9
November 2019	0	0	0	2	2	0	0	0	0	0	2	0	7	15
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	15
Fourth Quarter 2019 Subtotal	0	0	0	2	2	0	0	0	0	0	2	0	7	39
Total Project to Date	6	10	5	9	4	2	2	0	0	0	6	5	50	1,104

NuWell 120 (pure)- Western IRZ Expansion Injection System					
Period	SA-RW-54	SA-RW-55	SA-RW-56	Total Western IRZ Expansion System	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	1	0	1	3
February 2019	0	0	1	1	2
March 2019	0	0	0	0	7
April 2019	0	0	0	0	2
May 2019	0	0	0	0	0
June 2019	0	0	0	0	6
July 2019	0	0	0	0	4
August 2019	0	0	0	0	8
September 2019	0	0	0	0	10
October 2019	0	0	0	0	9
November 2019	0	0	0	0	15
December 2019	0	0	0	0	15
Fourth Quarter 2019 Subtotal	0	0	0	0	39
Total Project to Date	2	1	3	5	1,109

Table 3-10
Summary of Discharges to Groundwater, Source Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

NuWell 120 (pure) - Extraction Wells				
Period	SA-RW-22	SA-RW-23	SA-RW-25	Total Extraction Wells
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	0	0
February 2019	0	0	0	0
March 2019	0	0	0	0
April 2019	0	0	0	0
May 2019	0	0	0	0
June 2019	0	0	0	0
July 2019	0	0	0	0
August 2019	0	0	0	0
September 2019	0	0	0	0
October 2019	0	0	0	0
November 2019	0	0	0	0
December 2019	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0	0
Total Project to Date	1	3	2	6

NuWell 310 (pure) - Original Injection System													
Period	SA-RW-05	SA-RW-06	SA-RW-07	SA-RW-08	SA-RW-09	SA-RW-10	SA-RW-11	SA-RW-12	SA-RW-13	SA-RW-14	SA-RW-15	SA-RW-16	Total Original System
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Volume (gallons)
January 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
February 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
March 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
April 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
May 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
June 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
July 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
August 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
September 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
October 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Project to Date	6	4	3	4	0	0	23	21	19	6	0	0	85

Table 3-10
Summary of Discharges to Groundwater, Source Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

NuWell 310 (pure) - 2011 Expanded Injection System											
Period	SA-RW-01	SA-RW-02	SA-RW-03	SA-RW-04	SA-RW-17	SA-RW-18	SA-RW-19	SA-RW-20	SA-RW-21	Total 2011 Expanded System	Total Original and 2011 Expanded System
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	1	0	0	0	0	0	0	1	1
February 2019	0	0	0	0	0	0	0	0	0	0	0
March 2019	0	0	0	0	0	0	0	0	0	0	0
April 2019	0	0	0	0	0	0	0	0	0	0	0
May 2019	0	0	0	0	0	0	0	0	0	0	0
June 2019	0	0	0	0	0	0	0	0	0	0	0
July 2019	0	0	0	0	0	0	0	0	0	0	0
August 2019	0	0	1	0	0	0	0	0	0	1	1
September 2019	0	0	0	0	0	0	0	0	0	0	0
October 2019	0	0	0	0	0	0	0	0	0	0	0
November 2019	0	0	0	0	0	0	1	0	0	1	1
December 2019	0	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0	0	0	0	1	0	0	1	1
Total Project to Date	5	6	19	16	25	17	42	40	32	201	285

NuWell 310 (pure) - 2015 Expanded Injection System															
Period	SA-RW-26	SA-RW-27	SA-RW-28	SA-RW-29	SA-RW-30	SA-RW-31	SA-RW-32	SA-RW-33	SA-RW-34	SA-RW-35	SA-RW-36	SA-RW-37	SA-RW-38	Total 2015 Expanded System	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
February 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
March 2019	1	0	1	1	1	0	0	0	0	0	0	0	0	3	3
April 2019	1	0	0	0	0	1	0	0	0	0	0	0	0	1	1
May 2019	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1
June 2019	0	0	0	1	1	0	0	0	0	0	0	0	0	2	2
July 2019	0	1	1	0	0	1	1	0	0	0	0	0	0	3	3
August 2019	1	0	0	0	1	0	0	0	0	0	0	0	0	2	3
September 2019	0	2	0	0	0	0	0	0	0	0	0	0	0	2	2
October 2019	0	0	1	2	0	0	0	0	0	0	0	0	0	3	3
November 2019	0	0	0	0	0	1	0	0	0	0	0	0	0	1	3
December 2019	2	2	0	0	1	0	0	0	0	0	0	0	0	6	6
Fourth Quarter 2019 Subtotal	2	2	1	2	1	1	0	0	0	0	0	0	0	10	12
Total Project to Date	23	26	21	27	29	41	29	20	12	2	1	0	7	236	522

Table 3-10
Summary of Discharges to Groundwater, Source Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

NuWell 310 (pure) - 2017 Expansion and Replacement Injection System														
Period	SA-RW-39	SA-RW-40	SA-RW-41	SA-RW-42	SA-RW-43	SA-RW-44	SA-RW-45	SA-RW-46	SA-RW-47	SA-RW-48	SA-RW-50	SA-RW-51	Total 2017 Expanded System	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	1	0	0	0	0	0	0	0	0	0	0	1	1
February 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0
March 2019	1	0	0	0	0	0	0	0	0	0	0	0	1	4
April 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	2
May 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	1
June 2019	0	0	1	0	0	0	0	0	0	0	0	0	1	3
July 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	3
August 2019	0	0	1	0	0	0	0	0	0	0	0	0	1	4
September 2019	0	1	0	0	0	0	0	0	0	0	0	1	2	4
October 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	3
November 2019	0	0	0	1	0	0	0	0	0	0	1	0	2	4
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Fourth Quarter 2019 Subtotal	0	0	0	1	0	0	0	0	0	0	1	0	2	13
Total Project to Date	3	4	3	4	1	1	1	0	0	0	4	3	24	546

NuWell 310 (pure)- Western IRZ Expansion Injection System					
Period	SA-RW-54	SA-RW-55	SA-RW-56	Total Western IRZ Expansion System	Total Original and Expanded Systems
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	0	0	2
February 2019	0	0	0	0	1
March 2019	0	0	0	0	4
April 2019	0	0	0	0	2
May 2019	0	0	0	0	1
June 2019	0	0	0	0	3
July 2019	0	0	0	0	3
August 2019	0	0	0	0	4
September 2019	0	0	0	0	4
October 2019	0	0	0	0	3
November 2019	0	0	0	0	4
December 2019	0	0	0	0	6
Fourth Quarter 2019 Subtotal	0	0	0	0	13
Total Project to Date	1	0	1	3	548

Table 3-10
Summary of Discharges to Groundwater, Source Area In Situ Reactive Zone
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

NuWell 310 (pure) - Extraction Wells				
Period	SA-RW-22	SA-RW-23	SA-RW-25	Total Extraction Wells
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)
January 2019	0	0	0	0
February 2019	0	0	0	0
March 2019	0	0	0	0
April 2019	0	0	0	0
May 2019	0	0	0	0
June 2019	0	0	0	0
July 2019	0	0	0	0
August 2019	0	0	0	0
September 2019	0	0	0	0
October 2019	0	0	0	0
November 2019	0	0	0	0
December 2019	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0	0
Total Project to Date	1	3	1	4

Mud Nox, Well Development Compound (pure) ^b														
Period	SA-RW-26	SA-RW-27	SA-RW-28	SA-RW-29	SA-RW-30	SA-RW-31	SA-RW-32	SA-RW-33	SA-RW-34	SA-RW-35	SA-RW-36	SA-RW-37	SA-RW-38	Total Monthly Volume (gallons)
	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	
January 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0
February 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0
March 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0
April 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0
May 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0
June 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0
July 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0
August 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0
September 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0
October 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0
November 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0
December 2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fourth Quarter 2019 Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Project to Date	0	0	0	0	0	0	0	0	0	0	0	0	1	1

Notes:
% = percent
-- = not available; well was not installed.
IRZ = In Situ Reactive Zone
a. Totalizer volume error from July through September 2018 was retroactively corrected in the First Quarter of 2019 for SA-RW-43 through SA-RW-45; wells were not operational during the Third Quarter of 2018.
b. Mud Nox was pumped from the well after use, and the waste water was containerized in drums, profiled, and then properly disposed of offsite.

Table 3-13
Summary of Extraction Volumes and Discharges to Groundwater, Northwest Freshwater Injection System
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Well	Operating Period	Approximate Volume (gallons) ^a	Total Days in Period Pumping ^b	% of Period Actively Pumping ^c	Average Flow Rate (gpm) when Operating ^d	Average Flow Rate (gpm) for Period, based on Totalizer Readings ^e	NuWell 120*	NuWell 310*	Gaseous Carbon Dioxide	Liquid Carbon Dioxide
							Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)
Extraction										
FW-01 Extraction Well	Jan-2019	25,980	1	3	19	1	0	0	0	0
	Feb-2019	1,860	0	1	9	0	0	0	0	0
	Mar-2019	4,220	0	1	12	0	0	0	0	0
	Apr-2019	90	0	0	30	0	0	0	0	0
	May-2019	430	0	0	8	0	0	0	0	0
	Jun-2019	8,970	0	1	21	0	0	0	0	0
	July-2019	8,490	1	4	4	0	0	0	0	0
	Aug-2019	130	0	0	4	0	0	0	0	0
	Sep-2019	880	0	1	3	0	0	0	0	0
	Oct-2019	2,670	0	1	8	0	0	0	0	0
	Nov-2019	0	0	0	0	0	0	0	0	0
	Dec-2019	1,580	0	1	6	0	0	0	0	0
FW-02 Extraction Well	Jan-2019	32,950	1	3	23	1	0	0	0	0
	Feb-2019	3,960	0	1	12	0	0	0	0	0
	Mar-2019	4,990	0	1	15	0	0	0	0	0
	Apr-2019	7,050	0	1	17	0	0	0	0	0
	May-2019	10,590	0	1	28	0	0	0	0	0
	Jun-2019	5,920	0	1	16	0	0	0	0	0
	July-2019	16,220	1	4	9	0	0	0	0	0
	Aug-2019	120	0	0	5	0	0	0	0	0
	Sep-2019	2,330	0	1	8	0	0	0	0	0
	Oct-2019	2,100	0	1	7	0	0	0	0	0
	Nov-2019	0	0	0	0	0	0	0	0	0
	Dec-2019	1,370	0	1	6	0	0	0	0	0

Table 3-13
Summary of Extraction Volumes and Discharges to Groundwater, Northwest Freshwater Injection System
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Well	Operating Period	Approximate Volume (gallons) ^a	Total Days in Period Pumping ^b	% of Period Actively Pumping ^c	Average Flow Rate (gpm) when Operating ^d	Average Flow Rate (gpm) for Period, based on Totalizer Readings ^e	NuWell 120*	NuWell 310*	Gaseous Carbon Dioxide	Liquid Carbon Dioxide
							Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)
FW-03 Extraction Well	Jan-2019	2,998,270	10	34	199	67	0	0	0	0
	Feb-2019	1,888,620	7	24	195	47	0	0	0	0
	Mar-2019	2,375,450	8	24	218	53	0	0	0	0
	Apr-2019	2,913,489	10	32	212	67	0	0	0	0
	May-2019	2,956,320	11	35	187	66	0	0	0	0
	Jun-2019	3,852,040	14	46	195	89	0	0	0	0
	July-2019	4,615,459	16	51	202	103	0	0	0	0
	Aug-2019	5,077,520	18	58	196	114	0	0	0	0
	Sep-2019	4,957,109	17	58	199	115	0	0	0	0
	Oct-2019	3,765,270	12	39	216	84	0	0	0	0
	Nov-2019	4,492,509	13	43	241	104	0	0	0	0
	Dec-2019	3,286,300	9	31	242	76	0	0	0	0
FW-04 Extraction Well	Jan-2019	3,693,100	13	43	191	83	0	0	0	0
	Feb-2019	4,400,769	16	56	196	109	0	0	0	0
	Mar-2019	5,331,000	18	59	202	119	0	0	0	0
	Apr-2019	4,883,429	18	60	188	113	0	0	0	0
	May-2019	5,595,280	21	68	185	125	0	0	0	0
	Jun-2019	6,205,319	23	77	187	144	0	0	0	0
	July-2019	6,145,860	24	77	178	138	0	0	0	0
	Aug-2019	6,160,159	23	74	186	138	0	0	0	0
	Sep-2019	6,204,769	24	80	179	144	0	0	0	0
	Oct-2019	7,055,420	25	80	198	158	0	0	0	0
	Nov-2019	7,651,369	25	84	212	177	0	0	0	0
	Dec-2019	8,914,959	27	91	228	206	0	0	0	0
Fourth Quarter Extraction 2019		35,173,547								

Table 3-13
Summary of Extraction Volumes and Discharges to Groundwater, Northwest Freshwater Injection System
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Well	Operating Period	Approximate Volume (gallons) ^a	Total Days in Period Pumping ^b	% of Period Actively Pumping ^c	Average Flow Rate (gpm) when Operating ^d	Average Flow Rate (gpm) for Period, based on Totalizer Readings ^e	NuWell 120*	NuWell 310*	Gaseous Carbon Dioxide	Liquid Carbon Dioxide
							Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)
Injection										
IN-01	Jan-2019	327,780	31	100	7	7	0	0	0	0
Injection Well	Feb-2019	295,830	28	100	7	7	0	0	0	0
	Mar-2019	330,140	31	100	7	7	0	0	0	0
	Apr-2019	352,070	29	97	8	8	0	0	0	0
	May-2019	330,880	31	100	7	7	0	0	0	0
	Jun-2019	285,690	29	98	7	7	0	0	0	0
	July-2019	280,730	31	100	6	6	0	0	0	0
	Aug-2019	257,740	27	86	7	6	1	1	0	0
	Sep-2019	363,140	30	100	8	8	0	0	0	0
	Oct-2019	328,390	31	100	7	7	0	0	0	0
	Nov-2019	268,290	25	85	7	6	2	1	0	0
	Dec-2019	325,640	30	100	8	8	0	0	0	0
IN-02	Jan-2019	705,370	31	100	16	16	0	0	0	0
Injection Well	Feb-2019	636,110	28	100	16	16	0	0	0	0
	Mar-2019	606,320	27	86	16	14	1	1	0	0
	Apr-2019	607,040	26	86	16	14	1	1	0	0
	May-2019	705,180	31	100	16	16	0	0	0	0
	Jun-2019	683,069	30	100	16	16	0	0	0	0
	July-2019	705,900	31	100	16	16	0	0	0	0
	Aug-2019	705,710	31	100	16	16	0	0	0	0
	Sep-2019	584,600	26	86	16	14	2	1	0	0
	Oct-2019	704,270	31	100	16	16	0	0	0	0
	Nov-2019	680,940	30	100	16	16	0	0	0	0
	Dec-2019	605,130	26	85	16	14	2	1	0	0

Table 3-13
Summary of Extraction Volumes and Discharges to Groundwater, Northwest Freshwater Injection System
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Well	Operating Period	Approximate Volume (gallons) ^a	Total Days in Period Pumping ^b	% of Period Actively Pumping ^c	Average Flow Rate (gpm) when Operating ^d	Average Flow Rate (gpm) for Period, based on Totalizer Readings ^e	NuWell 120*	NuWell 310*	Gaseous Carbon Dioxide	Liquid Carbon Dioxide
							Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)
IN-03R Injection Well	Jan-2019	955,150	31	100	21	21	0	0	0	0
	Feb-2019	770,240	25	89	22	19	1	1	0	0
	Mar-2019	1,070,530	31	100	24	24	0	0	0	0
	Apr-2019 ^f	935,621	28	95	22	22	0	0	0	0
	May-2019	927,760	29	94	22	21	1	1	0	0
	Jun-2019	838,170	26	88	22	19	0	0	0	0
	July-2019	983,740	31	100	22	22	0	0	0	0
	Aug-2019	992,720	31	100	23	22	0	0	0	0
	Sep-2019	1,027,000	30	100	24	24	0	0	0	0
	Oct-2019	976,859	31	100	22	22	0	0	0	0
	Nov-2019	966,150	30	100	22	22	0	0	0	0
	Dec-2019	797,180	24	79	23	18	2	1	0	0
IN-04 Injection Well	Jan-2019	313,330	31	100	7	7	0	0	0	0
	Feb-2019	282,910	28	100	7	7	0	0	0	0
	Mar-2019	312,640	31	100	7	7	0	0	0	0
	Apr-2019	302,270	29	97	7	7	0	0	0	0
	May-2019	328,260	31	99	7	7	0	0	0	0
	Jun-2019	377,720	30	100	9	9	0	0	0	0
	July-2019	286,279	28	91	7	6	0	0	0	0
	Aug-2019	341,840	28	92	8	8	0	0	0	0
	Sep-2019	372,750	30	100	9	9	0	0	0	0
	Oct-2019	344,400	31	100	8	8	0	0	0	0
	Nov-2019	336,600	30	100	8	8	0	0	0	0
	Dec-2019	409,050	30	100	9	9	0	0	0	0

Table 3-13
Summary of Extraction Volumes and Discharges to Groundwater, Northwest Freshwater Injection System
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Well	Operating Period	Approximate Volume (gallons) ^a	Total Days in Period Pumping ^b	% of Period Actively Pumping ^c	Average Flow Rate (gpm) when Operating ^d	Average Flow Rate (gpm) for Period, based on Totalizer Readings ^e	NuWell 120*	NuWell 310*	Gaseous Carbon Dioxide	Liquid Carbon Dioxide
							Total Monthly Volume (gallons)	Total Monthly Volume (gallons)	Total Monthly Volume (pounds)	Total Monthly Volume (pounds)
IN-05 Injection Well	Jan-2019	541,400	29	95	13	12	0	0	0	0
	Feb-2019	515,130	28	100	13	13	0	0	0	0
	Mar-2019	570,790	31	100	13	13	0	0	0	0
	Apr-2019	552,190	29	97	13	13	0	0	0	0
	May-2019	565,350	30	97	13	13	0	0	0	0
	Jun-2019	586,620	30	100	14	14	0	0	0	0
	July-2019	493,580	27	86	13	11	2	1	0	0
	Aug-2019	572,330	31	97	13	13	0	0	0	0
	Sep-2019	411,320	22	74	13	10	2	1	0	0
	Oct-2019	558,430	30	97	13	13	0	0	0	0
	Nov-2019	552,770	30	100	13	13	0	0	0	0
	Dec-2019	572,530	30	100	13	13	0	0	0	0
IN-06 Injection Well	Jan-2019	998,070	31	100	22	22	0	0	0	0
	Feb-2019	965,550	28	100	24	24	0	0	0	0
	Mar-2019	941,450	31	100	21	21	0	0	0	0
	Apr-2019 ^f	901,258	28	95	22	22	0	0	0	0
	May-2019	982,080	31	99	22	22	0	0	0	0
	Jun-2019	953,300	30	100	22	22	0	0	0	0
	July-2019	1,082,030	31	100	24	24	0	0	0	0
	Aug-2019	1,014,380	30	97	23	23	0	0	0	0
	Sep-2019	1,039,850	30	100	24	24	0	0	0	0
	Oct-2019	987,780	31	100	22	22	0	0	0	0
	Nov-2019	972,530	30	100	23	23	0	0	0	0
	Dec-2019	1,118,409	30	100	26	26	0	0	0	0
Fourth Quarter Injection 2019		11,505,348	-	-	-	-	6	3	0	0
Annual Injection Volume (January 2019 to December 2019)		111,092,497	-	-	-	211	-	-	-	-
Total Injection Volume to Date		376,390,555	-	-	-	-	297.7	152.9	0.0	0.0

Table 3-13
Summary of Extraction Volumes and Discharges to Groundwater, Northwest Freshwater Injection System
Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and
Northwest Freshwater Injection Projects
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Notes:

Average injection rates (when pumping) in gpm for individual wells calculated from monthly volume and total days operating.

Average injection rates (for period) (gpm) for individual wells calculated from monthly volume and total calendar days in month.

Annual average injection rate calculated from annual volume and 365 days January 2019 to December 2019.

^a Calculated by difference of totalizer readings.

^b The data collection system records whether a well is on (=1) or off (=0) each minute. An average of uptime for each day is calculated as the percentage of time the well is on.
The total days in period pumping is the sum of those daily averages.

^c Calculated by dividing the number of days pumping by the total number of days in the month and multiplying by 100.

^d Calculated by dividing the monthly injection volume by Total Days in Period Pumping, and converting to gpm.

^e Calculated by dividing the monthly injection volume by the number of days in the month and converting to gpm.

^f Monthly volume and average flow rates are based off flow meter readings due to issues with the totalizer.

* = NuWell 120 and 320 were added during chemical rehabilitation. Volumes listed are for pure chemicals.

% = percent

gpm = gallons per minute

Table 2-2
Remedial Systems Operational Plan and Actual Flow Rates
Fourth Quarter 2019 Agricultural Treatment Units Monitoring Report
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Month	Northern ATUs		Southern ATUs	
	Operational Plan Flow Rate of Water Applied to Fields (gpm)	Actual Flow Rate of Water Applied to Fields (gpm)	Operational Plan Flow Rate of Water Applied to Fields (gpm)	Actual Flow Rate of Water Applied to Fields (gpm)
January 2019	575 (517)	586	55-85 (49)	140
February 2019	575 (517)	613	55-85 (49)	152
March 2019	700 (630)	659	150-200 (135)	209
April 2019	800 (720)	778	150-200 (135)	350
May 2019	900 (810)	1009	260-300 (234)	347
June 2019	1000 (900)	1056	330-380 (297)	404
July 2019	1000 (900)	1077	330-380 (297)	375
August 2019	1000 (900)	1145	300-350 (297)	408
September 2019	950 (855)	1072	270-300 (243)	386
October 2019	575 (517)	630	185-210 (166)	311
November 2019	575 (517)	595	85-100 (76)	188
December 2019	575 (517)	615	85-100 (76)	154

Notes:

Operational plan allowance for April 2018 through March 2019 were proposed in the Annual Cleanup Status and Effectiveness Report (January to December 2017) (Arcadis 2018).

Operational plan allowance for April 2019 through March 2020 were proposed in the Annual Cleanup Status and Effectiveness Report (January to December 2018) (Arcadis 2019).

Acronyms and Abbreviations:

() = notification minimum; a 10% allowance from the operational plan allowance is permitted without requiring notification

Arcadis = Arcadis U.S., Inc.

ATU = Agricultural Treatment Unit

gpm = gallons per minute

Water Board = California Regional Water Quality Control Board, Lahontan Region

References:

Arcadis. 2018. Annual Cleanup Status and Effectiveness Report (January to December 2017), Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California. February 28.

Arcadis. 2019. Annual Cleanup Status and Effectiveness Report (January to December 2018), Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California. February 28.

Table 2-3
Extraction Rates for ATU Supply Wells
Fourth Quarter 2019 Agricultural Treatment Units Monitoring Report
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Period	Extraction Well Average Rates (gpm) ^{d,e}																										
	EX-01	EX-02	EX-03	EX-04	EX-09	EX-23	EX-24	EX-25	EX-26	EX-27	EX-28	EX-34	C-01	C-02	C-03	C-04	G-1R	G-2R	G-5R	Y-01 ^d	Y-03	EX-31	EX-32	EX-33 ^d	EX-35	EX-37	
January 2019	37	78	0	0	0	0	0	75	0	0	0	28	0	7	6	0	0	59	0	3	7	4	0	9	35	1	
February 2019	70	69	0	0	0	0	0	75	0	0	0	28	0	7	6	0	0	60	0	3	7	4	0	8	29	2	
March 2019	80	88	0	0	0	0	0	75	0	0	0	29	0	8	6	0	0	60	0	4	7	4	0	9	25	4	
April 2019	139	80	0	0	0	0	0	75	0	2	0	28	0	9	5	0	0	60	2	4	7	4	0	9	24	4	
May 2019	162	80	0	0	0	0	0	70	0	0	0	26	0	11	8	0	0	60	0	4	5	4	0	9	28	3	
June 2019	165	119	0	0	0	0	0	62	0	0	0	25	0	9	9	0	0	60	0	4	5	4	0	9	29	3	
July 2019	67	186	0	0	0	0	0	81	0	45	0	24	0	10	9	0	0	59	19	4	5	4	0	8	30	2	
August 2019	156	199	0	0	0	0	0	107	0	57	0	20	0	7	8	0	0	57	0	3	5	4	0	8	28	2	
September 2019	149	200	0	0	0	0	0	107	0	38	0	19	0	3	6	0	0	56	0	4	5	4	0	8	29	2	
October 2019	55	54	0	0	0	0	0	81	0	1	0	22	1	2	5	1	0	56	1	3	5	4	0	8	26	3	
November 2019	24	89	0	0	0	0	0	93	0	0	0	22	0	5	5	0	0	55	0	3	5	4	0	8	28	3	
December 2019	124	86	0	0	0	0	0	81	0	0	0	22	0	5	5	0	0	56	0	2	5	4	0	9	28	2	
Fourth Quarter 2019 Average	68	76	0	0	0	0	0	85	0	0	0	22	0	4	5	0	0	56	0	3	5	4	0	9	27	2	
Annual (gpm), January 2019 through December 2019	102	111	0	0	0	0	0	82	0	12	0	24	0	7	7	0	0	58	2	3	6	4	0	9	28	2	
Annual (mgd), January 2019 through December 2019	0.147	0.160	0	0	0	0	0	0.118	0	0.017	0	0.035	0	0.010	0.010	0	0	0.084	0.003	0.004	0.009	0.006	0	0.013	0.040	0.003	

Table 2-3
Extraction Rates for ATU Supply Wells
Fourth Quarter 2019 Agricultural Treatment Units Monitoring Report
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Period	Extraction Well Average Rates (gpm) ^{d,e}																										
	IW-01	IW-02	IW-03	EX-29	EX-30 ^d	X-04	X-05	X-06	X-09	X-12	X-13	EX-38 ^d	EX-39 ^d	EX-40	EX-41	EX-42	EX-43	EX-44	EX-45	EX-46	EX-47	EX-48	EX-49	EX-50	EX-51	EX-52	
January 2019	108	1	0	12	26	0	0	0	0	0	1	1	2	0	0	3	17	13	4	20	15	13	0	1	0	7	
February 2019	123	4	0	12	26	0	0	0	0	0	0	0	6	0	0	0	24	1	4	29	21	9	0	4	0	25	
March 2019	169	9	0	12	26	0	0	0	0	0	0	0	5	0	0	0	27	7	5	32	25	20	0	10	0	18	
April 2019	191	91	0	12	26	0	0	0	0	0	5	0	8	1	0	2	13	8	5	14	9	1	7	12	0	43	
May 2019	193	136	176	12	27	0	0	2	0	0	0	0	6	1	0	0	0	0	5	0	0	0	0	13	0	39	
June 2019	200	138	203	12	26	0	0	4	0	0	0	0	7	1	0	0	0	0	5	0	0	1	0	13	0	48	
July 2019	200	133	211	12	23	0	0	4	0	0	0	0	7	1	0	0	0	0	5	3	0	0	0	13	19	45	
August 2019	199	127	192	12	20	0	0	4	0	1	1	0	12	1	0	7	0	0	4	0	0	0	0	13	38	40	
September 2019	192	108	175	11	20	0	0	2	0	0	0	0	15	0	0	12	0	0	0	0	0	0	0	23	35	35	
October 2019	169	74	45	11	22	0	0	3	0	0	0	6	13	0	0	7	0	0	0	0	0	0	0	16	21	28	
November 2019	186	61	21	11	22	0	0	3	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	11	0	5	
December 2019	199	0	0	11	22	0	0	3	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	9	0	0	
Fourth Quarter 2019 Average	185	45	22	11	22	0	0	3	0	0	0	2	11	0	0	2	0	0	0	0	0	0	0	12	7	11	
Annual (gpm), January 2019 through December 2019	177	73	85	12	24	0	0	2	0	0	1	1	8	0	0	3	7	2	3	8	6	4	1	12	9	28	
Annual (mgd), January 2019 through December 2019	0.255	0.105	0.122	0.017	0.035	0	0	0.003	0	0	0.001	0.001	0.012	0	0	0.004	0.010	0.003	0.004	0.012	0.009	0.006	0.001	0.017	0.013	0.040	

Table 2-3
Extraction Rates for ATU Supply Wells
Fourth Quarter 2019 Agricultural Treatment Units Monitoring Report
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Period	Extraction Well Average Rates (gpm) ^{d,e,f}														ATU Discharge Rates (gpm) ^{a,d}						
	EX-53 ^d	EX-54 ^{a,f}	EX-55 ^{e,f}	EX-56 ^f	EX-59 ^f	EX-60 ^f	EX-61 ^f	EX-62 ^f	EX-63 ^f	EX-64 ^{d,f}	EX-65 ^{d,f}	EX-66 ^{e,f,h}	EX-67 ^{e,f,h}	SC-IW-15 ^f	DVD ^{b,d}	Community East	Fairview	Cottrell	Gorman	Ranch	Yang
January 2019	165	26	54	70	37	10	17	49	--	--	--	--	--	3	166	21	119	103	72	111	134
February 2019	178	28	56	53	39	10	17	50	--	--	--	--	--	3	211	69	83	90	96	91	125
March 2019	160	28	55	75	38	9	16	50	--	--	--	--	--	3	136	166	43	128	132	162	101
April 2019	189	3	53	81	45	10	16	49	7	10	14	28	49	3	268	165	184	82	141	173	114
May 2019	205	0	49	75	47	10	16	45	10	17	28	27	88	6	207	180	167	148	130	316	208
June 2019	204	2	47	104	50	10	16	48	10	17	28	23	87	0	302	206	199	198	93	322	141
July 2019	200	1	43	110	46	10	15	48	8	16	21	21	59	0	262	181	194	140	191	291	192
August 2019	200	0	38	115	44	10	16	48	6	15	20	20	76	0	229	198	210	107	97	445	267
September 2019	200	0	37	111	40	10	16	47	6	14	16	16	69	0	212	202	184	105	99	436	221
October 2019	195	0	34	110	33	10	16	8	5	11	16	13	56	0	151	136	175	64	44	236	136
November 2019	174	0	28	96	23	9	14	0	3	9	11	10	50	0	154	91	97	101	81	159	101
December 2019	189	0	31	70	28	8	12	0	3	8	9	10	49	0	77	36	118	123	68	202	144
Fourth Quarter 2019 Average	186	0	31	92	28	9	14	3	4	9	12	11	51	0	127	88	130	96	64	199	127
Annual (gpm), January 2019 through December 2019	188	7	44	89	39	10	16	37	6	13	18	19	65	1	198	138	148	116	104	245	157
Annual (mgd), January 2019 through December 2019	0.271	0.010	0.063	0.128	0.056	0.014	0.023	0.053	0.009	0.019	0.026	0.027	0.094	0.001	0.285	0.199	0.213	0.167	0.150	0.353	0.226

Table 2-3
Extraction Rates for ATU Supply Wells
Fourth Quarter 2019 Agricultural Treatment Units Monitoring Report
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Period	Diversion from Northern Extraction Wells to the SCRIA/CA Systems (gpm) ^c	Diversion from Southern Extraction wells to SCRIA/CA/SA (gpm)	Diversion from SA System to Southern ATU (gpm) ^g	Total ATU Discharge Rate (gpm)
January 2019	86	101	0	726
February 2019	117	105	0	765
March 2019	130	86	0	869
April 2019	203	6	46	1,127
May 2019	216	0	76	1,357
June 2019	220	0	90	1,460
July 2019	217	0	48	1,451
August 2019	215	0	55	1,552
September 2019	217	0	46	1,459
October 2019	213	0	27	941
November 2019	190	0	0	784
December 2019	206	0	0	769
Fourth Quarter 2019 Average	203	0	9	831
Annual (gpm), January 2019 through December 2019	186	25	32	1,105
Annual (mgd), January 2019 through December 2019	0.268	0.036	0.046	1.591

Table 2-3
Extraction Rates for ATU Supply Wells
Fourth Quarter 2019 Agricultural Treatment Units Monitoring Report
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Notes:

^a = Average monthly discharge rates for each ATU represents the monthly rate of groundwater discharge to land surface at that ATU. Historically, discharge volume for the DVD has been calculated by adding the flows at the extraction wells (EX-01, EX-02, EX-03, EX-04, EX-09, EX-23, EX-24, EX-25, EX-26, EX-27, EX-28, and EX-34). Starting Fourth Quarter 2015, totalizer readings from the DVD West and DVD East pivots are were also used to calculate the total flow rates at the DVD.

^b = Operation at DVD Northwest Field was stopped in January 2017.

^c = Water is diverted from the NATUs to SCRIA/CA systems as needed.

^d = Average monthly extraction rate for EX-33, EX-53, and DVD east pivot for January 2019, January and February 2019, and January through March 2019, respectively, were calculated based on instantaneous flow rates due to mechanical issues with the totalizer. Average monthly extraction rate for DVD east pivot for April 2019 was calculated based on instantaneous flow rates due to mechanical issues with the totalizer. Average monthly extraction rate for EX-63, EX-64, and EX-65 for April through December 2019 were calculated based on instantaneous flow rates due to mechanical issues with the totalizer. Average monthly extraction rates for EX-30 and Y-1 for July through September 2019, and August 2019, respectively, were calculated based on instantaneous flow rates due to mechanical issues with the totalizer. Average monthly extraction rates for Y-1, EX-38, and EX-39 for November and December 2019, October 2019, and December 2019, respectively, were calculated based on instantaneous flow rates due to mechanical issues with the totalizer.

^e = Flow from EX-54, EX-55, EX-66, and EX-67 are sent directly to the SA. EX-57 and EX-58 are being utilized as monitoring wells, not as ATU extraction wells, therefore the wells are not included on this table.

^f = EX-63, EX-64, and EX-65 were started on April 17, 2019. EX-66 was started on April 4, 2019. EX-67 was started on April 11, 2019. EX-66 was started on April 4, 2019. EX-67 was started on April 11, 2019.

^g = Water is diverted from the SA IRZ to SATUs as needed beginning May 2018. Extraction water from the SA is a mixture of water from SA extraction wells SA-RW-22, SA-RW-23, SA-RW-25, EX-54, EX-55, EX-66, and EX-67.

^h = Flow-rate values from July through September 2019 were retroactively corrected in the Fourth Quarter of 2019 for EX-66; flow-rate values for EX-67 were erroneously reported for EX-66 during this time.

Acronyms and Abbreviations:

- = not applicable
- N = Northern
- S = Southern
- ATU = Agricultural Treatment Unit
- CA = Central Area
- DVD = Desert View Dairy
- gpm = gallons per minute
- mgd = millions of gallons per day
- SA = Source Area
- SCRIA = South Central Reinjection Area

Table 2-7
Extraction Rates for Wells Associated with Lower Aquifer Remedial Activities
Fourth Quarter 2019 Agricultural Treatment Units Monitoring Report
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Period	Extraction Well Average Rates ^a (gpm)					
	EX-26	EX-29	EX-30 ^c	EX-37	Ryken-8 ^b	Ryken-9 ^b
January 2019	0	12	26	1	0	0
February 2019	0	12	26	2	0	0
March 2019	0	12	26	4	0	0
April 2019	0	12	26	4	0	0
May 2019	0	12	27	3	0	0
June 2019	0	12	26	3	0	0
July 2019	0	12	23	2	0	0
August 2019	0	12	20	2	0	0
September 2019	0	11	20	2	0	0
October 2019	0	11	22	3	0	0
November 2019	0	11	22	3	0	0
December 2019	0	11	22	2	0	0
Fourth Quarter 2019 Average	0	11	22	2	0	0

Notes:

EX-29 and EX-30 are Upper Aquifer extraction wells, EX-26 and EX-37 are screened over the Upper and Lower Aquifers, and Ryken-8 and Ryken-9 are Lower Aquifer extraction wells.

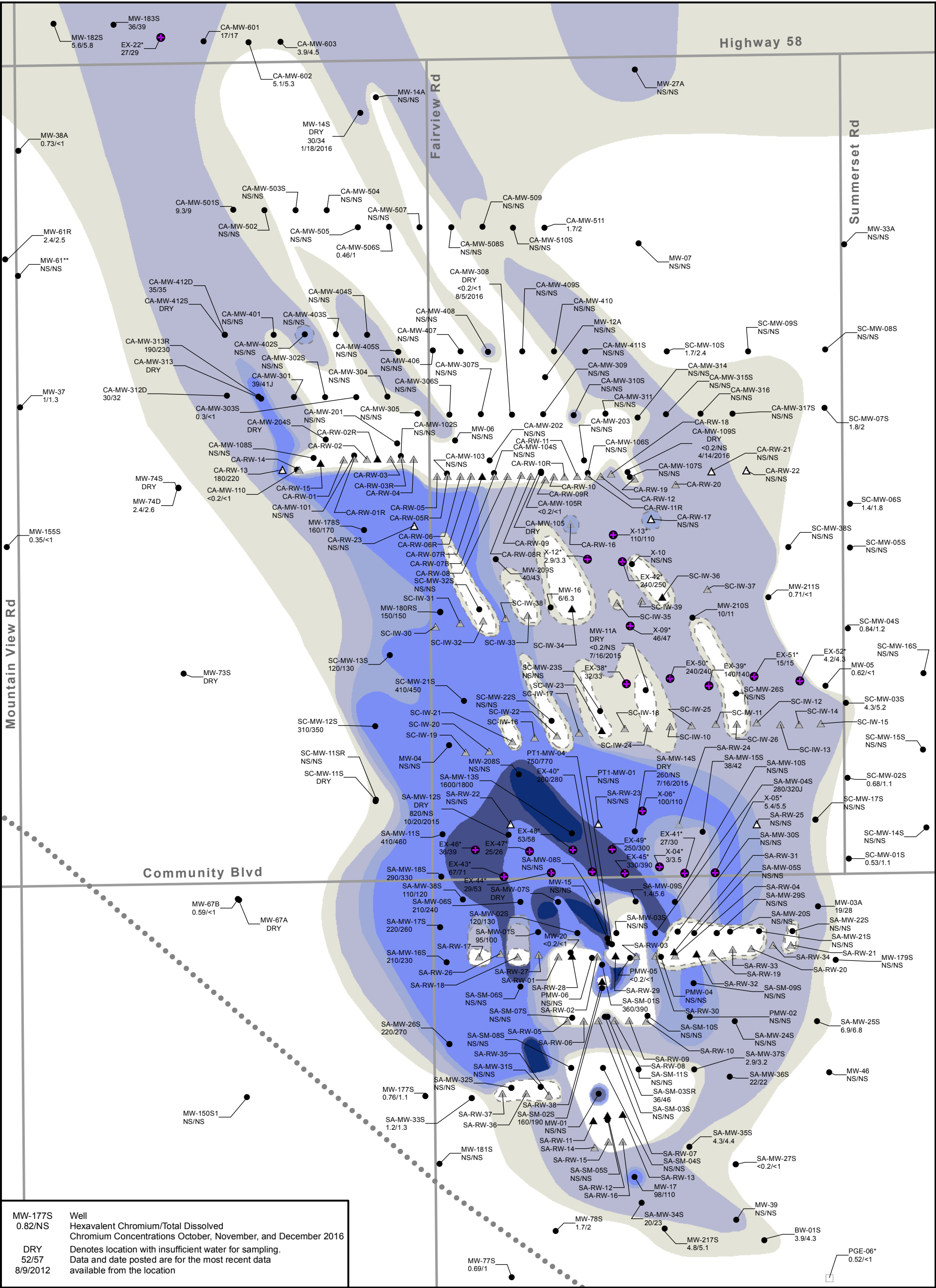
^a = Average monthly extraction rate.

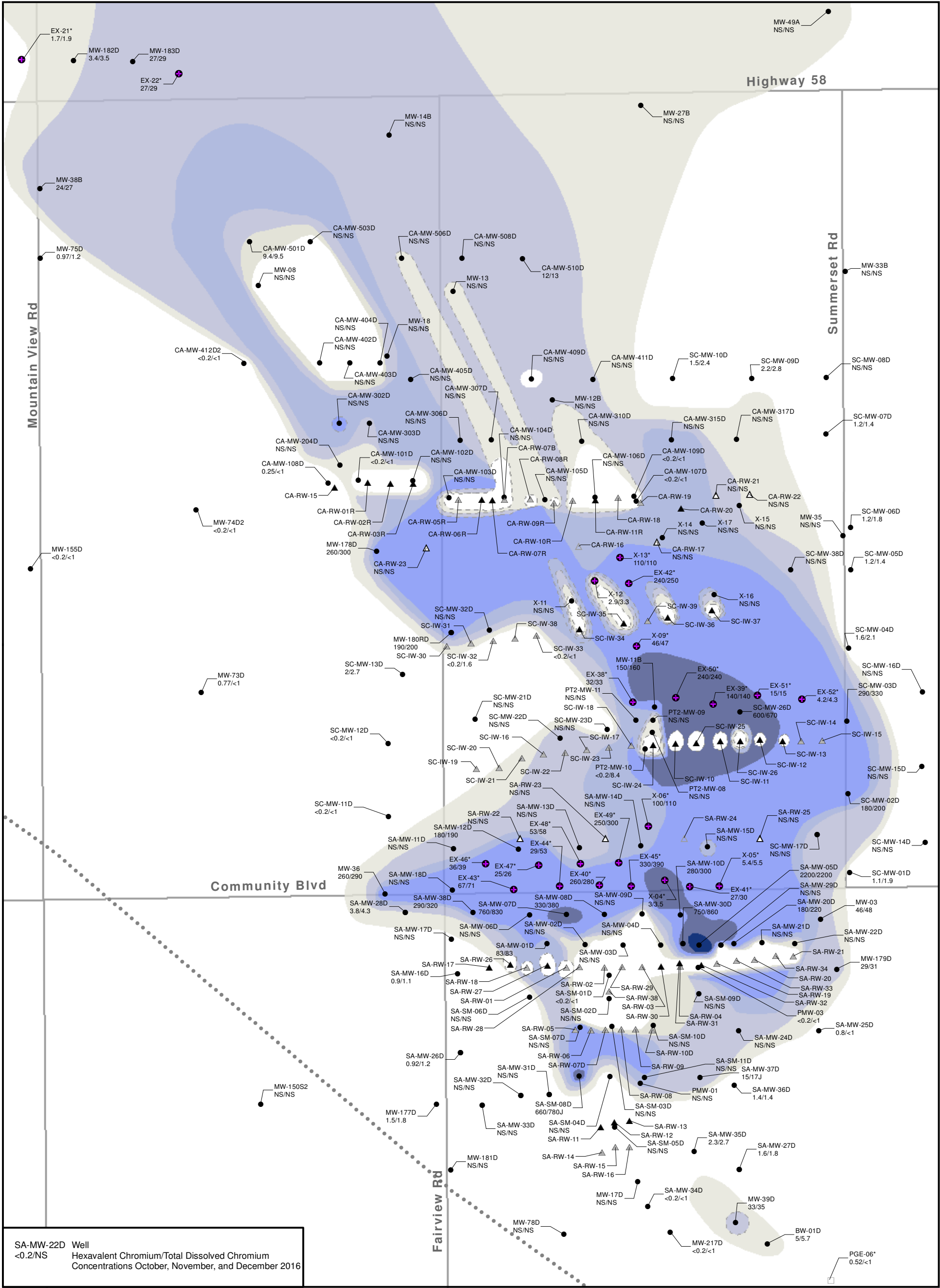
^b = Extraction from Ryken-8 and Ryken-9 has been limited to minimize the potential for downward gradients from the Upper Aquifer to the Lower Aquifer.

^c = Average monthly extraction rate for EX-30 for July through September 2019 were calculated based on instantaneous flow rates due to mechanical issues with the totalizer.

Acronyms and Abbreviations:

gpm = gallons per minute





LEGEND

- Monitoring Well
- Extraction Well
- ▲ Active IRZ Extraction Well
- ▲ Active IRZ Injection Well
- ▲ Inactive IRZ Extraction Well
- ▲ Inactive IRZ Injection Well
- PG&E Compressor Station and non-PG&E Extraction Well

- Chromium Concentrations Less than 3.1 µg/L
- Chromium Concentrations Between 3.1 and 10 µg/L
- Chromium Concentrations Between 10 and 50 µg/L
- Chromium Concentrations Between 50 and 100 µg/L
- Chromium Concentrations Between 100 and 500 µg/L
- Chromium Concentrations Between 500 and 1,000 µg/L
- Chromium Concentrations Equal or Greater than 1,000 µg/L
- Inferred Concentration Contour
- Approximate Location of Fault Trace is Inferred and There is No Surface Expression (Stamos et al. 2001)

WORK CITED:
Stamos, C.L., P. Martin, T. Nishikawa, and B.F. Cox. 2001. *Simulation of Ground-Water Flow in the Mojave River Basin, California*. U.S. Geological Survey Water-Resources Investigations

NOTES:
µg/L = Micrograms per Liter
IRZ = In Situ Reactive Zone
J = Estimated Result
NS = Not Sampled
*Extraction wells screened across both shallow and deep zones of the upper aquifer are not used in contouring.

N

0 250 500 Feet

FIGURE 3-3
IRZ AREA TOTAL DISSOLVED CHROMIUM AND
HEXAVALENT CHROMIUM CONCENTRATIONS
(DEEP ZONE OF THE UPPER AQUIFER)
FOURTH QUARTER 2016

FOURTH QUARTER 2016 MONITORING REPORT FOR
THE IN SITU REACTIVE ZONE AND NORTHWEST
FRESHWATER INJECTION PROJECTS
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA

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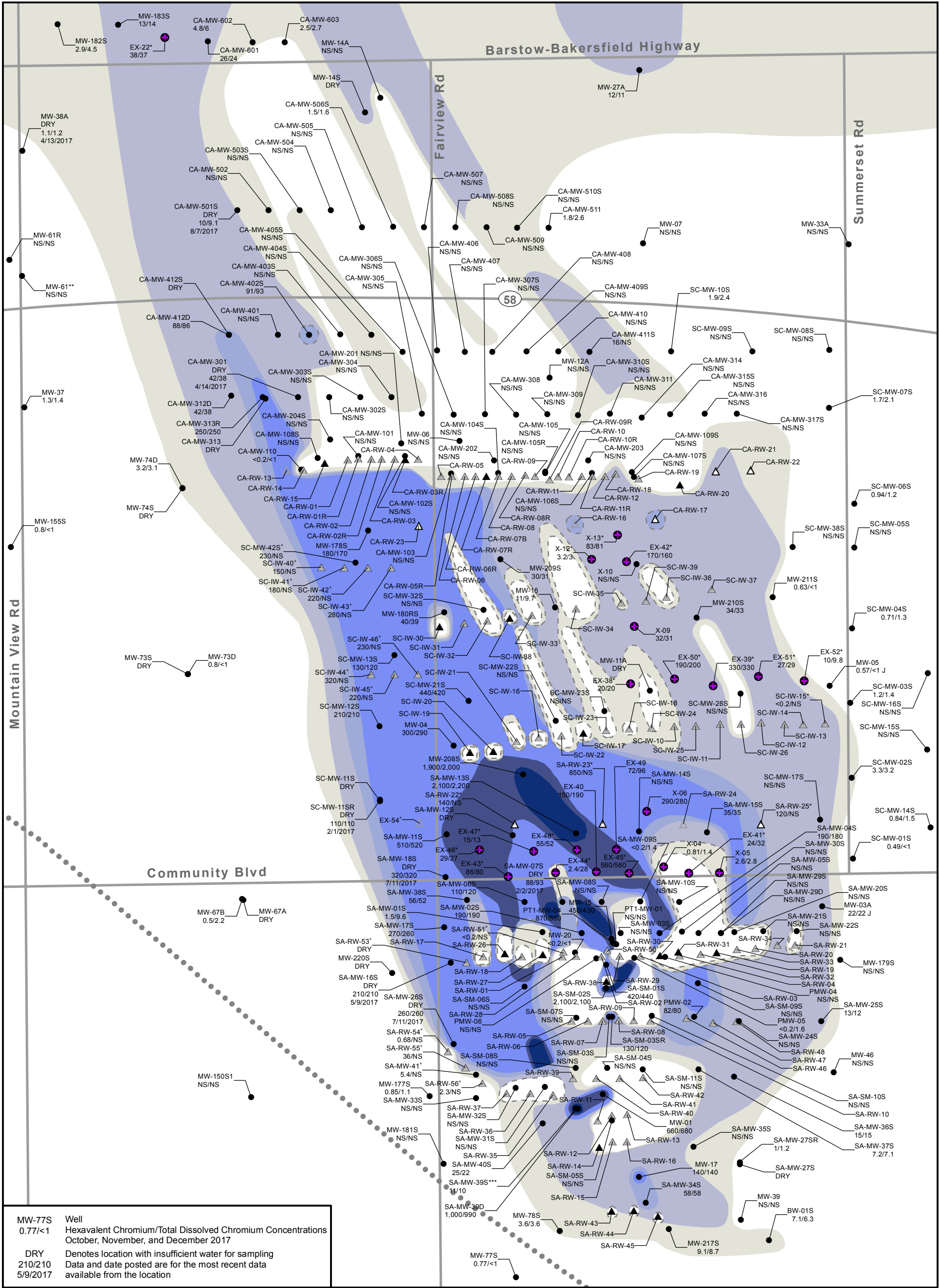


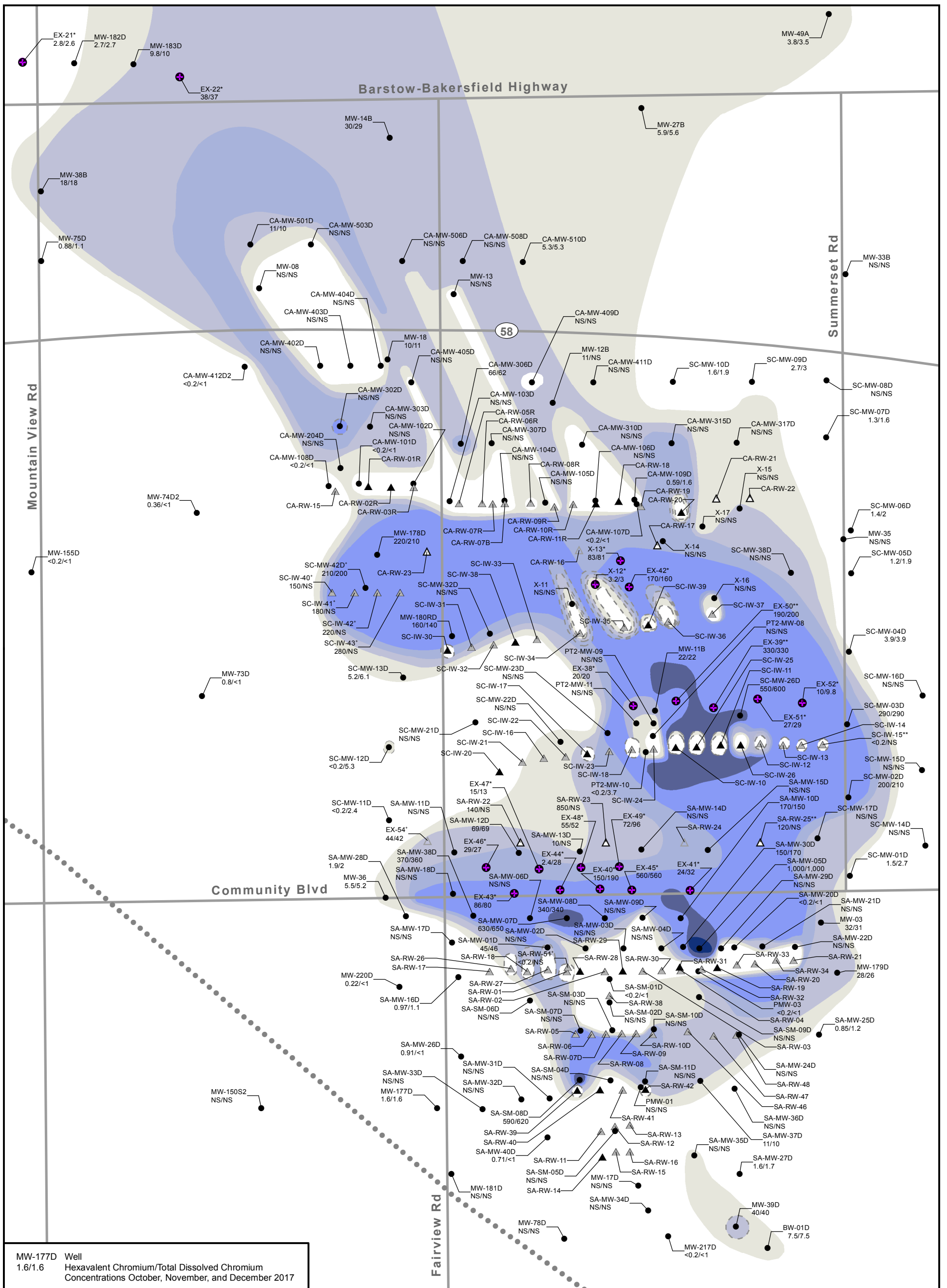
FIGURE 3-2
IRZ AREA TOTAL DISSOLVED CHROMIUM AND
HEXAVALENT CHROMIUM CONCENTRATIONS
(SHALLOW ZONE OF THE UPPER AQUIFER)
FOURTH QUARTER 2017

FOURTH QUARTER 2017 MONITORING REPORT FOR
THE IN SITU REACTIVE ZONE AND NORTHWEST
FRESHWATER INJECTION PROJECTS

PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA

0 300 600 Feet

N



LEGEND

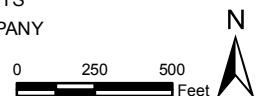
- Monitoring Well
- ⊕ Extraction Well
- △ Active IRZ Extraction Well
- ▲ Active IRZ Injection Well
- ◁ Inactive IRZ Extraction Well
- ▴ Inactive IRZ Injection Well
- PG&E Compressor Station and non-PG&E Extraction Well

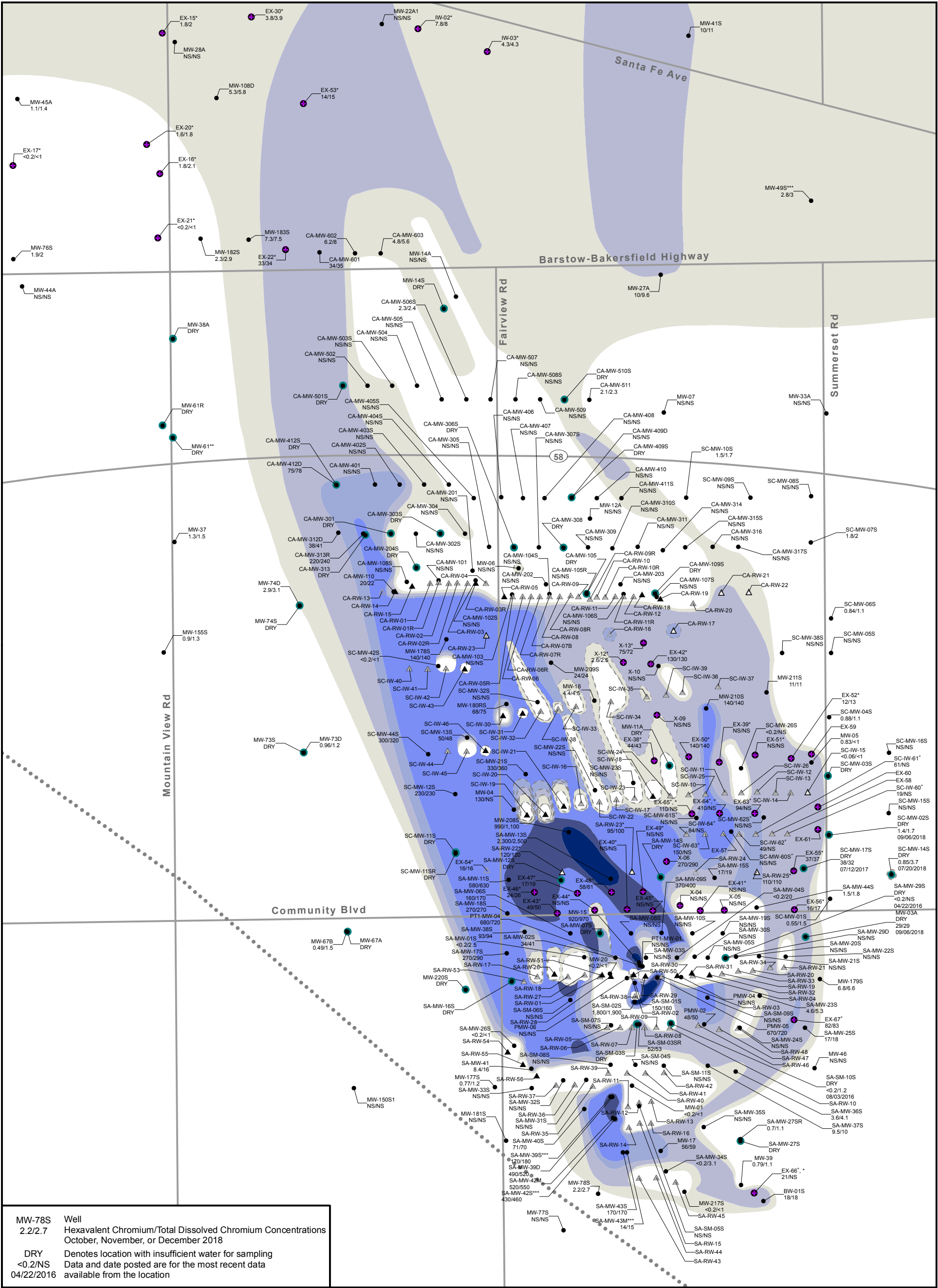
Chromium Concentrations Less than 3.1 $\mu\text{g/L}$
 Chromium Concentrations Between 3.1 and 10 $\mu\text{g/L}$
 Chromium Concentrations Between 10 and 50 $\mu\text{g/L}$
 Chromium Concentrations Between 50 and 100 $\mu\text{g/L}$
 Chromium Concentrations Between 100 and 500 $\mu\text{g/L}$
 Chromium Concentrations Between 500 and 1,000 $\mu\text{g/L}$
 Chromium Concentrations Equal to or Greater than 1,000 $\mu\text{g/L}$
 Inferred Concentration Contour
 Approximate Location of Fault Trace is Inferred and There is No Surface Expression (Stamos et al. 2001)

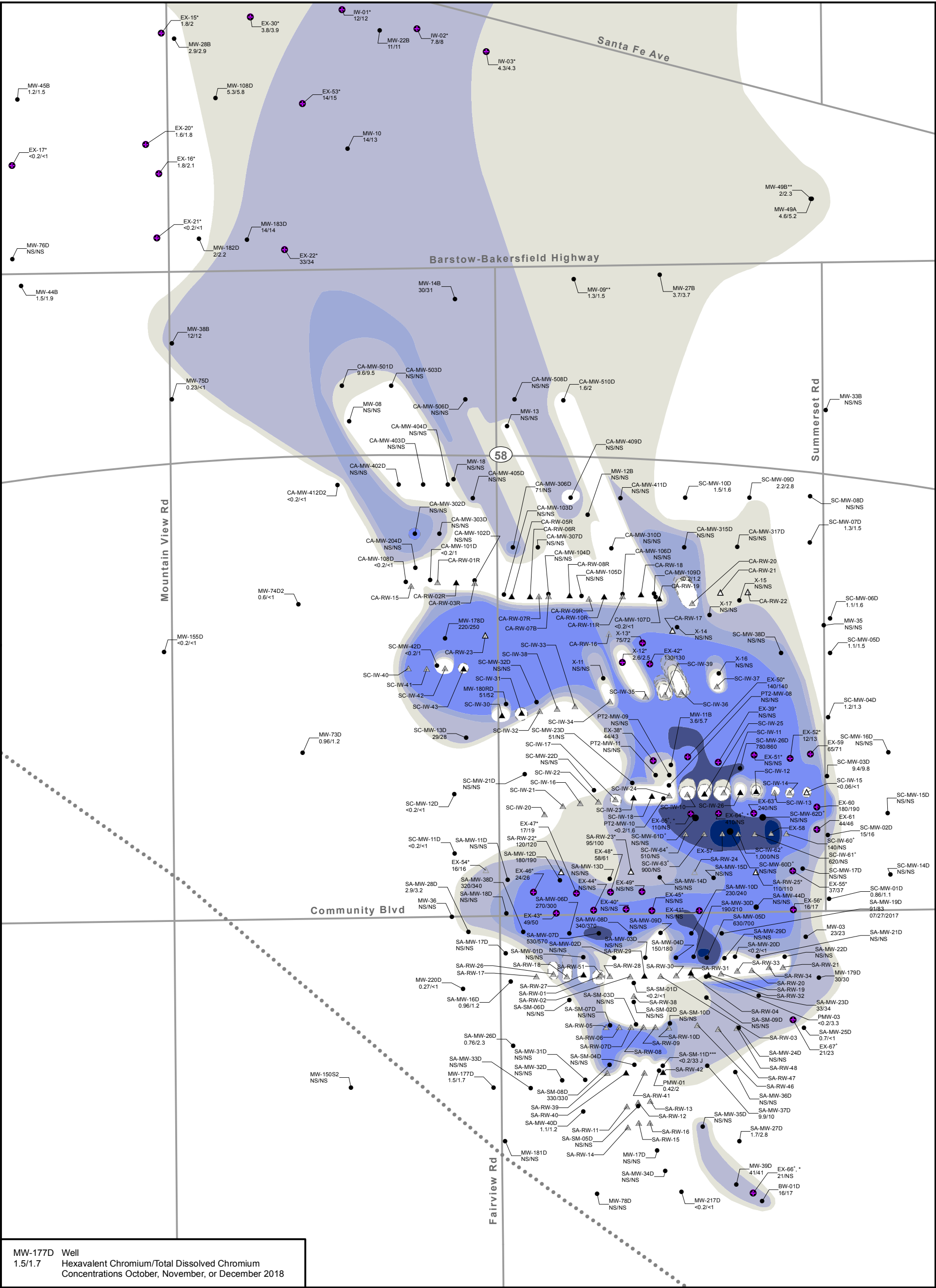
NOTES:
 µg/L = Micrograms per Liter
 IRZ = In Situ Reactive Zone
 NS = Not Sampled
 < = Below Reporting Limit (as shown)
 bgs = below ground surface
 *Remedial wells screened across
 both shallow and deep zones
 of the upper aquifer; not used
 in contouring
 *Location is approximated;
 survey to be conducted in the
 First Quarter of 2018

FIGURE 3-3
IRZ AREA TOTAL DISSOLVED CHROMIUM AND
HEXAVALENT CHROMIUM CONCENTRATIONS
(DEEP ZONE OF THE UPPER AQUIFER)
FOURTH QUARTER 2017

FOURTH QUARTER 2017 MONITORING REPORT FOR
THE IN SITU REACTIVE ZONE AND NORTHWEST
FRESHWATER INJECTION PROJECTS
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA 0 250 500







LEGEND

- Monitoring Well
- Extraction Well
- Active IRZ Extraction Well
- Active IRZ Injection Well
- Inactive IRZ Extraction Well
- Inactive IRZ Injection Well

Chromium Concentrations Less than 3.1 µg/L

Chromium Concentrations Between 3.1 and 10 µg/L

Chromium Concentrations Between 10 and 50 µg/L

Chromium Concentrations Between 50 and 100 µg/L

Chromium Concentrations Between 100 and 500 µg/L

Chromium Concentrations Between 500 and 1,000 µg/L

Chromium Concentrations Equal to or Greater than 1,000 µg/L

Inferred Concentration Contour

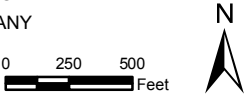
Approximate Location of Fault Trace is Inferred and There is No Surface Expression (Stamos et al. 2001)

WORK CITED:
Stamos, C.L., P. Martin, T. Nishikawa, and B.F. Cox. 2001. *Simulation of Ground-Water Flow in the Mojave River Basin, California*. U.S. Geological Survey Water-Resources Investigations Report 01-4002, Version 3. Prepared in cooperation with the Mojave Water Agency.

NOTES:
µg/L = Micrograms per Liter
IRZ = In Situ Reactive Zone
J = Estimated Result
NS = Not Sampled
< = Below Reporting Limit (as shown)
*Remedial wells screened across both shallow and deep zones of the upper aquifer; Data not used in contouring
**Data not used in contouring
***Total dissolved chromium data not used in contouring
* Location is approximated; survey pending

FIGURE 3-3
IRZ AREA TOTAL DISSOLVED CHROMIUM AND
HEXAVALENT CHROMIUM CONCENTRATIONS
(DEEP ZONE OF THE UPPER AQUIFER)
FOURTH QUARTER 2018

FOURTH QUARTER 2018 MONITORING REPORT FOR
THE IN SITU REACTIVE ZONE AND NORTHWEST
FRESHWATER INJECTION PROJECTS
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA



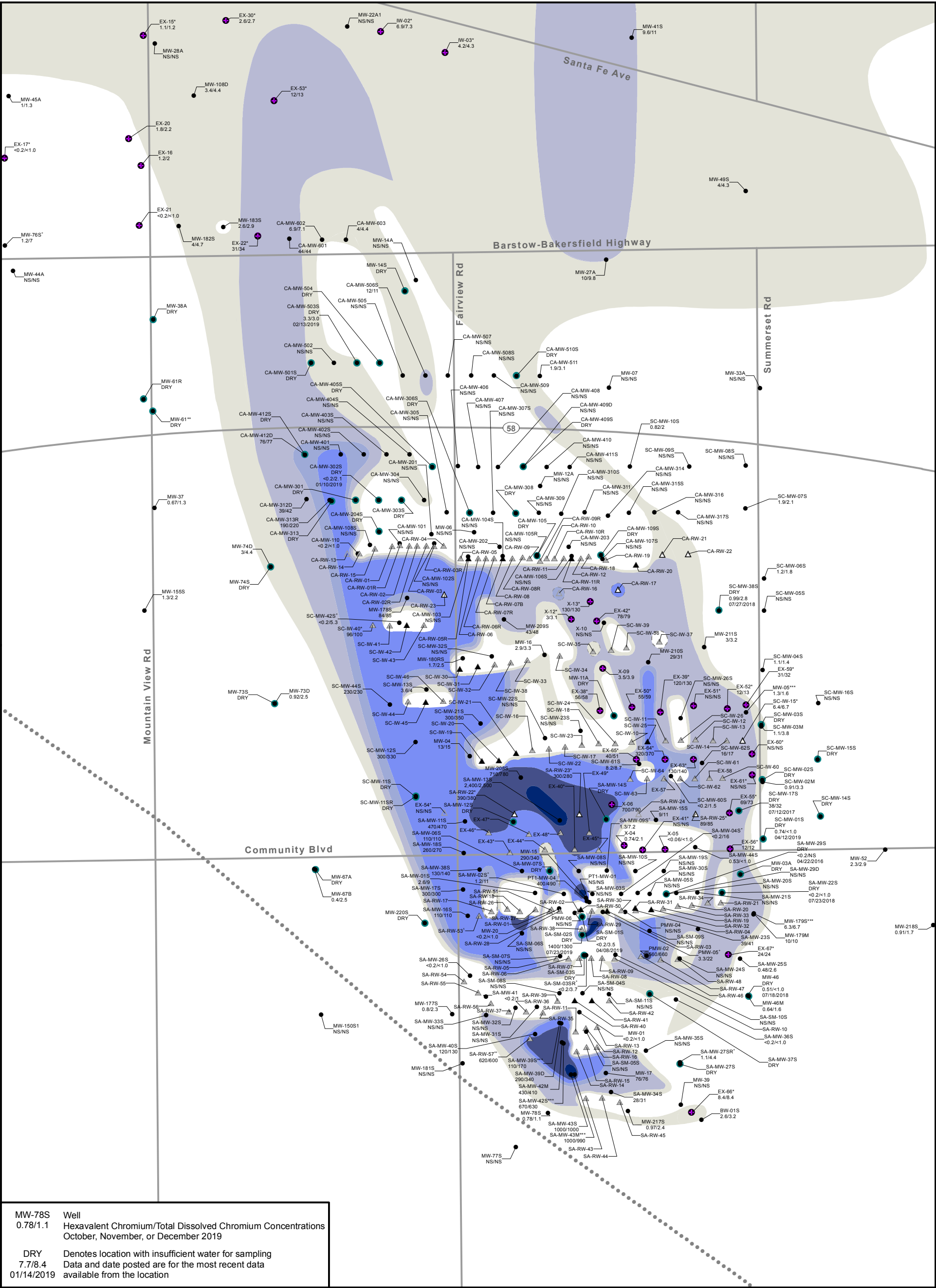
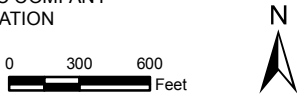
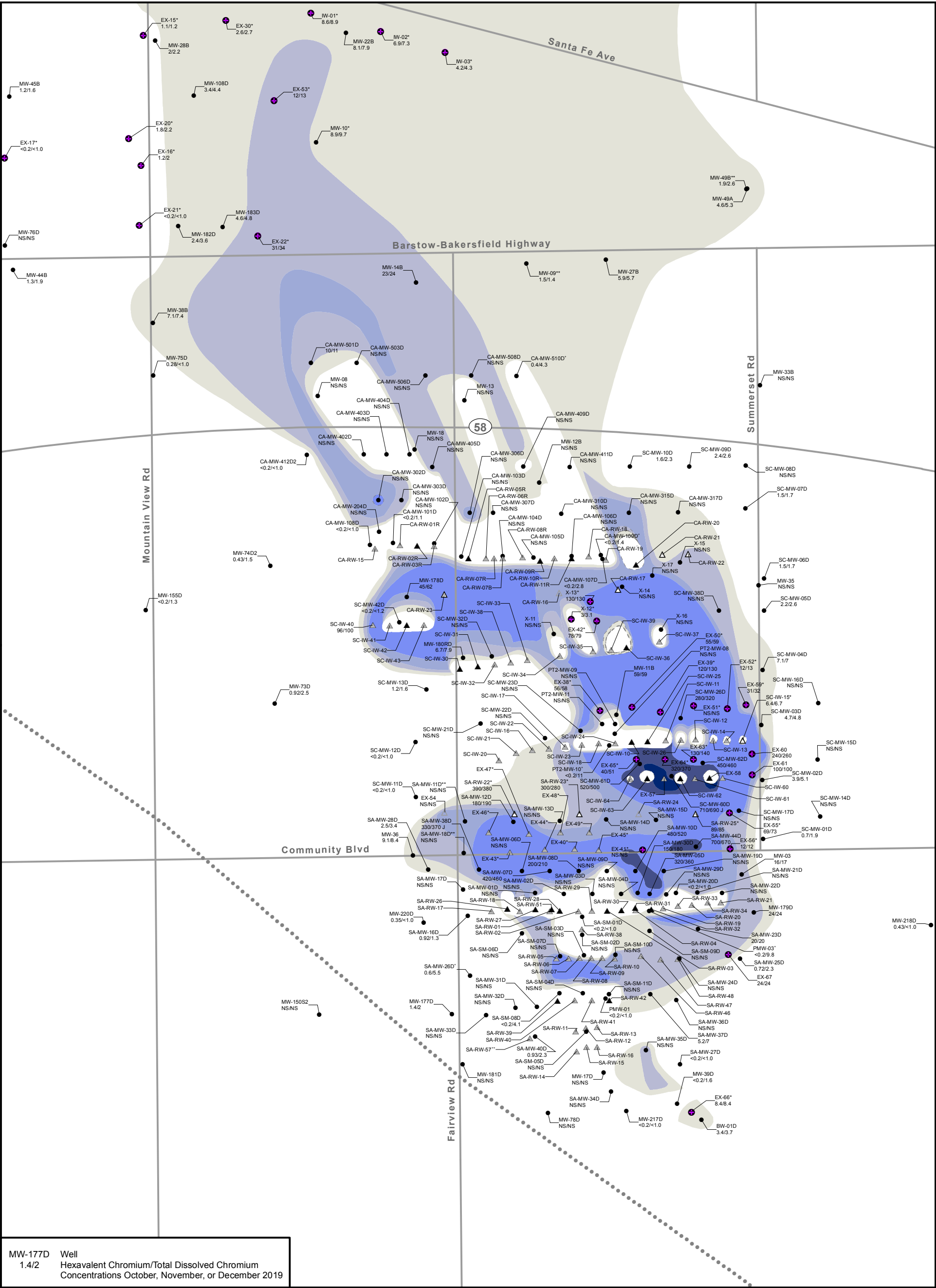


FIGURE 3-2
IRZ AREA TOTAL DISSOLVED CHROMIUM AND
HEXAVALENT CHROMIUM CONCENTRATIONS
(SHALLOW ZONE OF THE UPPER AQUIFER)
FOURTH QUARTER 2019

FOURTH QUARTER 2019 MONITORING REPORT FOR
THE IN SITU REACTIVE ZONE AND NORTHWEST
FRESHWATER INJECTION PROJECTS
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA





- LEGEND**
- Monitoring Well
 - ⊕ Extraction Well
 - △ Active IRZ Extraction Well
 - ▲ Active IRZ Injection Well
 - △ Inactive IRZ Extraction Well
 - ▲ Inactive IRZ Injection Well

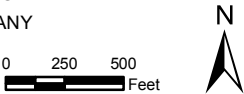
- Chromium Concentrations Less than 3.1 µg/L
- Chromium Concentrations Between 3.1 and 10 µg/L
- Chromium Concentrations Between 10 and 50 µg/L
- Chromium Concentrations Between 50 and 100 µg/L
- Chromium Concentrations Between 100 and 500 µg/L
- Chromium Concentrations Between 500 and 1,000 µg/L
- Chromium Concentrations Equal to or Greater than 1,000 µg/L
- - - Inferred Concentration Contour
- Approximate Location of Fault Trace is Inferred and There is No Surface Expression (Stamos et al. 2001)

WORK CITED:
Stamos, C.L., P. Martin, T. Nishikawa, and B.F. Cox. 2001. *Simulation of Ground-Water Flow in the Mojave River Basin, California*. U.S. Geological Survey Water-Resources Investigations Report 01-4002, Version 3. Prepared in cooperation with the Mojave Water Agency.

NOTES:
µg/L = Micrograms per Liter
IRZ = In Situ Reactive Zone
J = Estimated Result
NS = Not Sampled
< = Below Reporting Limit (as shown)
*Remedial wells screened across both shallow and deep zones of the upper aquifer; Data not used in contouring
**Data not used in contouring
*Total dissolved chromium concentration data not used in contouring
**Location is approximated; survey pending

**FIGURE 3-3
IRZ AREA TOTAL DISSOLVED CHROMIUM AND
HEXAVALENT CHROMIUM CONCENTRATIONS
(DEEP ZONE OF THE UPPER AQUIFER)
FOURTH QUARTER 2019**

FOURTH QUARTER 2019 MONITORING REPORT FOR THE IN SITU REACTIVE ZONE AND NORTHWEST FRESHWATER INJECTION PROJECTS
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA



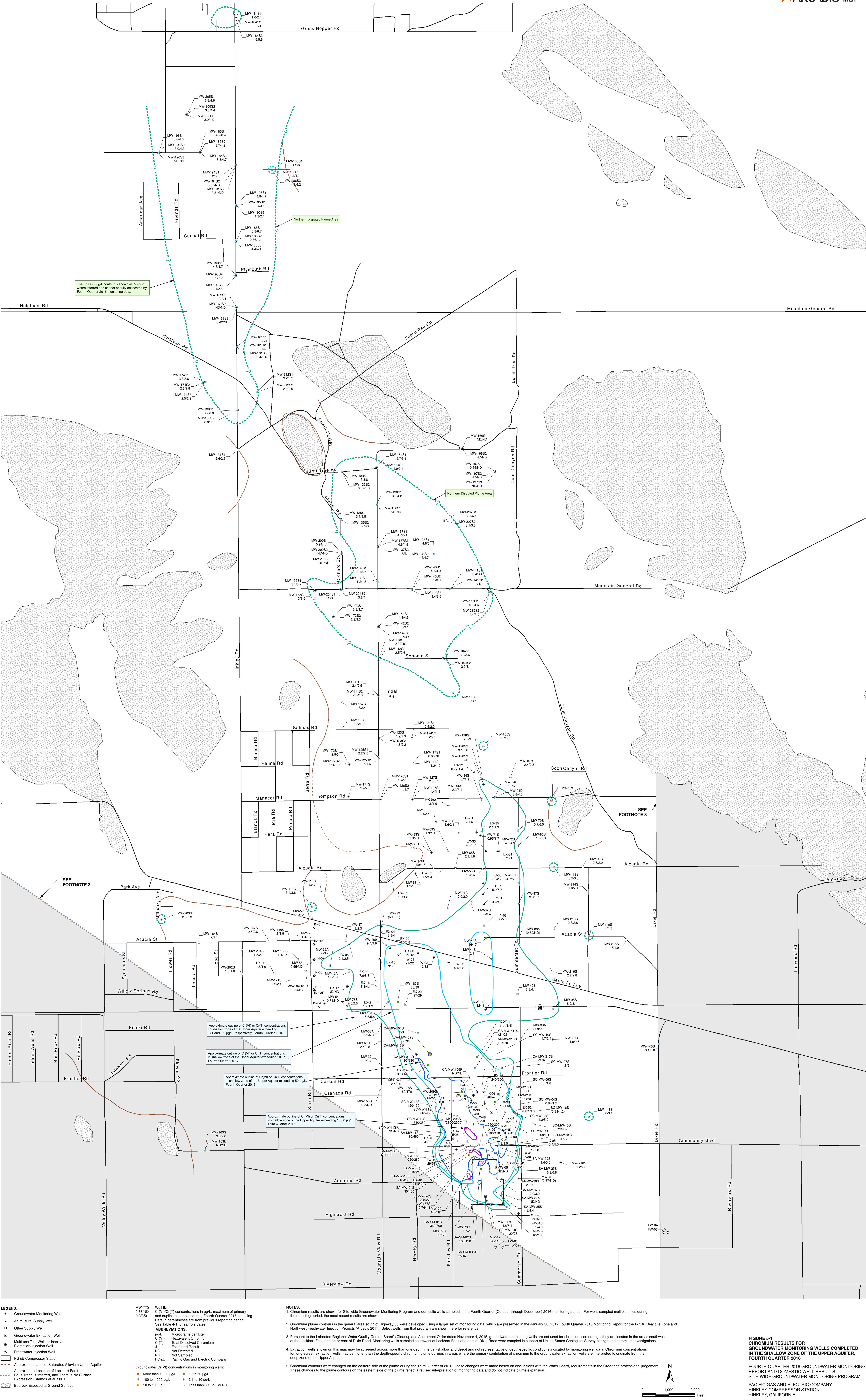
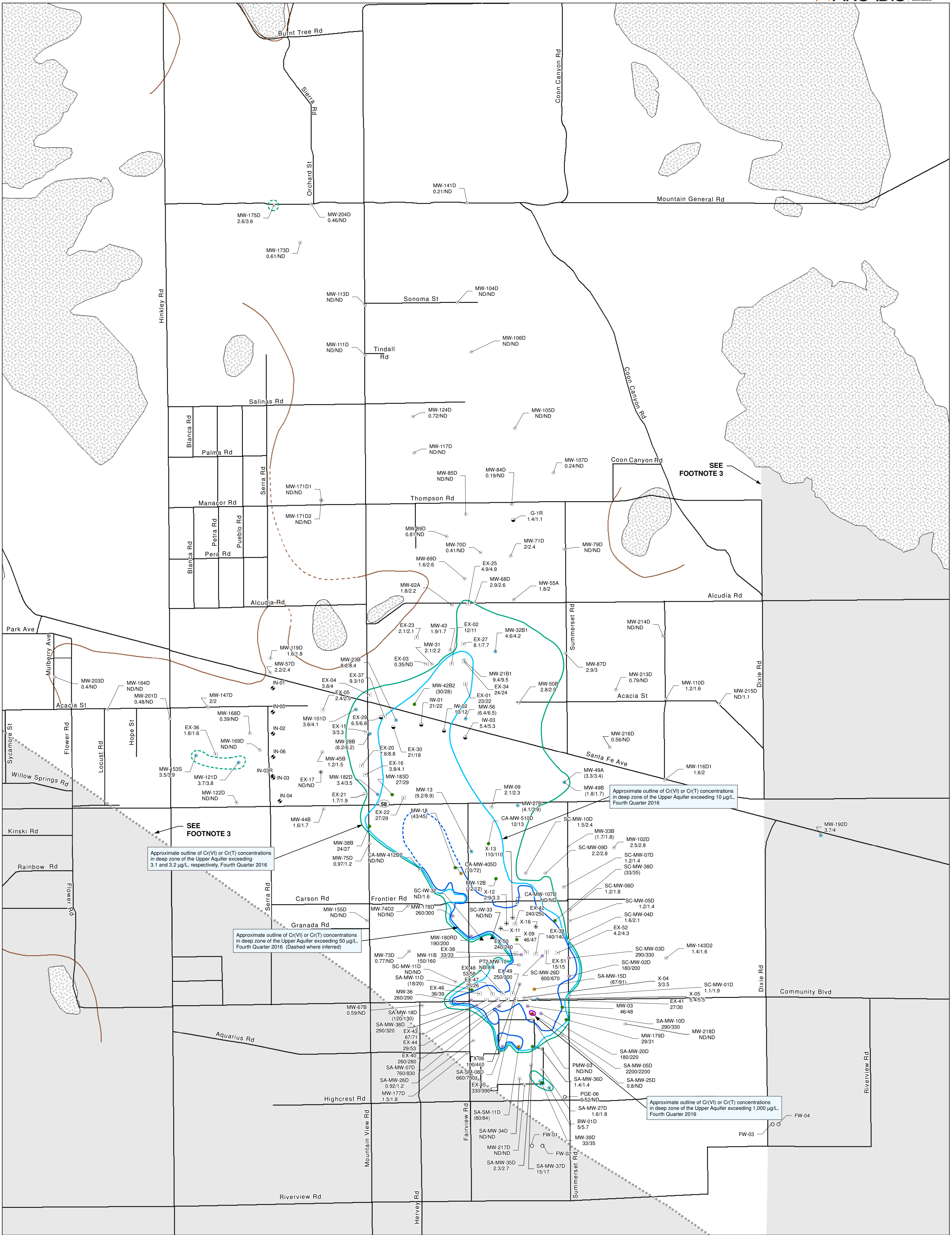


FIGURE 5-1
CHROMIUM RESULTS FOR
GROUNDWATER MONITORING WELLS COMPLETED
IN THE SHALLOW ZONE OF THE UPPER AQUIFER,
FOURTH QUARTER 2016

FOURTH QUARTER 2016 GROUNDWATER MONITORING
REPORT AND DOMESTIC WELL RESULTS
SITE-WIDE GROUNDWATER MONITORING PROGRAM

PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA



- LEGEND:**
- Groundwater Monitoring Well
 - ◐ Agricultural Supply Well
 - Other Supply Well
 - ▣ Groundwater Extraction Well
 - ⊕ Multiuse Test Well, or Inactive Extraction/Injection Well
 - ▲ Inactive In Situ Reaction Zone
 - ◆ Freshwater Injection Well
 - ▢ PG&E Compressor Station

MW-77D Well ID
1.0\1.2 Cr(VI)/Cr(T) concentrations in µg/L; maximum of
(43/35) primary and duplicate samples during Fourth
Quarter 2016 sampling.
Data in parentheses are from previous reporting
See Table 4-1 for sample dates.

ABBREVIATIONS:

µg/L	Micrograms per Liter
Cr(VI)	Hexavalent Chromium
Cr(T)	Total Dissolved Chromium
J	Estimated Result
ND	Not Detected
NS	Not Sampled
PG&E	Pacific Gas and Electric Company

Groundwater Cr(VI) concentrations in monitoring wells:

● More than 1,000 µg/L	● 10 to 50 µg/L
● 100 to 1,000 µg/L	● 3.1 to 10 µg/L
● 50 to 100 µg/L	● Less than 3.1 µg/L or ND

NOTES:

1. Chromium results are shown for Site-wide Groundwater Monitoring Program and domestic wells sampled in the Fourth Quarter (October through December) 2016 monitoring period. For wells sampled multiple times during the reporting period, the most recent results are shown.

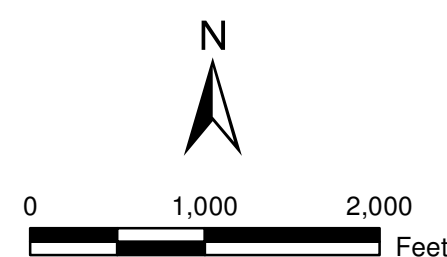
2. Chromium plume contours in the general area south of Highway 58 were developed using a larger set of monitoring data, which are presented in the January 30, 2017 Fourth Quarter 2016 Monitoring Report for the In Situ Reactive Zone and Northwest Freshwater Injection Projects (Arcadis 2017). Select wells from that program are shown here for reference.

3. Pursuant to the Lahonton Regional Water Quality Control Board's Cleanup and Abatement Order dated November 4, 2015, groundwater monitoring wells are not used for chromium contouring if they are located in the areas southwest of the Lockhart Fault and on or east of Dixie Road. Monitoring wells sampled southwest of Lockhart Fault and east of Dixie Road were sampled in support of United States Geological Survey background chromium investigations.

**FIGURE 5-2
CHROMIUM RESULTS FOR
GROUNDWATER MONITORING WELLS
COMPLETED IN THE DEEP ZONE OF THE
UPPER AQUIFER, FOURTH QUARTER 2016**

FOURTH QUARTER 2016 GROUNDWATER MONITORING
REPORT AND DOMESTIC WELL RESULTS
SITE-WIDE GROUNDWATER MONITORING PROGRAM

PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA



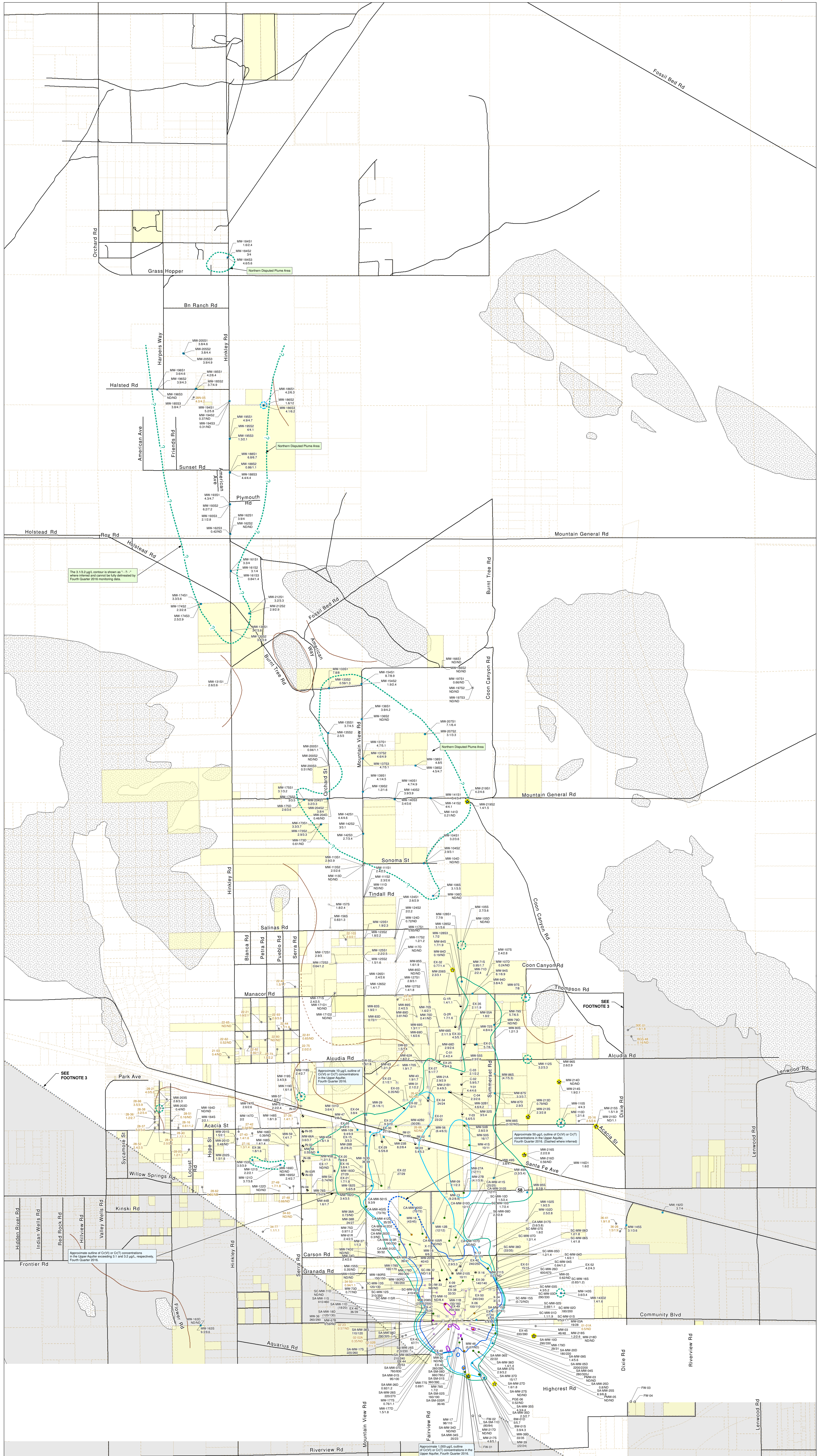


FIGURE 5-3
CHROMIUM RESULTS FOR FOURTH QUARTER 2016
GROUNDWATER MONITORING AND DOMESTIC
WELL SAMPLING AND MAXIMUM COMPOSITE
PLUME OUTLINE IN UPPER AQUIFER

FOURTH QUARTER 2016 GROUNDWATER MONITORING REPORT AND DOMESTIC WELL RESULTS
SITE-WIDE GROUNDWATER MONITORING PROGRAM
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA



LEGEND:

- Monitoring Well
- Other Supply Well
- Groundwater Extraction Well (active)
- Multi-use Test Well, or Inactive Extraction/Injection Well
- Freshwater Injection Well
- PG&E Compressor Station
- Approximate Limit of Saturated Alluvium Upper Aquifer
- Approximate Location of Lockhart Fault
- Fault Trace is Inferred, and There is No Surface Expression (Stamos et al., 2001)
- Bedrock Exposed at Ground Surface

Abbreviations:

- µg/L: Micrograms per Liter
- Cr(VI): Hexavalent Chromium
- Cr(T): Total Dissolved Chromium
- J: Estimated Result
- ND: Not Detected
- NS: Not Sampled
- PG&E: Pacific Gas and Electric Company

Groundwater Cr(VI) concentrations in monitoring wells:

- More than 1,000 µg/L
- 100 to 1,000 µg/L
- 50 to 100 µg/L
- 10 to 50 µg/L
- 3.1 to 10 µg/L
- Less than 3.1 µg/L or ND

Notes:

- Chromium results are shown for Site-wide Groundwater Monitoring Program and domestic wells sampled in the Fourth Quarter (October through December) 2017 monitoring period. For wells sampled multiple times during the reporting period, the most recent results are shown.
- Chromium plume contours in the general area south of Highway 58 were developed using a larger set of monitoring data, which are presented in the Fourth Quarter 2017 Monitoring Report for the In Situ Reactive Zone and Northwest Freshwater Injection Projects (Arcadis 2017). Select wells from that program are shown here for reference.
- Pursuant to the Lahontan Regional Water Quality Control Board's Cleanup and Abatement Order dated November 4, 2015 (Water Board 2015), groundwater monitoring wells are not used for chromium contouring if they are located in the areas southwest of the Lockhart Fault and on or east of Dixie Road. Monitoring wells sampled southwest of Lockhart Fault and east of Dixie Road were sampled in support of United States Geological Survey background chromium investigations.
- Extraction wells shown on this map may be screened across more than one depth interval (shallow and deep) and not representative of depth-specific conditions indicated by monitoring well data. Chromium concentrations for long-screen extraction wells may be higher than the depth-specific chromium plume outlines in areas where the primary contribution of chromium to the groundwater extraction wells are interpreted to originate from the deep zone of the Upper Aquifer.

WORK CITED:

Arcadis. 2018. Fourth Quarter 2017 Monitoring Report for the In Situ Reactive Zone and Northwest Freshwater Injection Projects, Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California. California Regional Water Quality Control Board, Lahontan Region Order No. REV-2008-0014 (Waste Discharge Requirements Identification No. 68369107001). January 30.

Stamos, C.L., P. Martin, T. Nishikawa, and B.F. Cox. 2001. Simulation of Ground-Water Flow in the Mojave River Basin, California. U.S. Geological Survey Water-Resources Investigations Report 01-4002, Version 3. Prepared in cooperation with the Mojave Water Agency.

Water Board. 2015. Cleanup and Abatement Order No. REV-2015-0068 Requiring Pacific Gas and Electric Company to Cleanup and Abate Waste Discharges of Total and Hexavalent Chromium to the Groundwaters of the Mojave Hydrologic Unit. November 4.

FIGURE 5-1
CHROMIUM RESULTS FOR
GROUNDWATER MONITORING WELLS COMPLETED
IN THE SHALLOW ZONE OF THE UPPER AQUIFER,
FOURTH QUARTER 2017

FOURTH QUARTER 2017 GROUNDWATER MONITORING REPORT AND DOMESTIC WELL RESULTS
SITE-WIDE GROUNDWATER MONITORING PROGRAM

PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA

MW-39D Well ID
40/40 Cr(VI)/Cr(T) concentrations in µg/L; maximum of primary
(3/2.9) and duplicate samples during Fourth Quarter 2017 sampling.
Data in parentheses are from previous reporting period.
See Table E-1 for sample dates.

Groundwater Cr(VI) concentrations in monitoring wells:

● More than 1,000 µg/L	● 10 to 50 µg/L
● 100 to 1,000 µg/L	● 3.1 to 10 µg/L
● 50 to 100 µg/L	○ Less than 3.1 µg/L or ND

ABBREVIATIONS:

µg/L	Micrograms per Liter
Cr(VI)	Hexavalent Chromium
Cr(T)	Total Dissolved Chromium
ND	Estimated Result
NS	Not Detected
PG&E	Not Sampled
	Pacific Gas and Electric Company

ABBREVIATIONS:

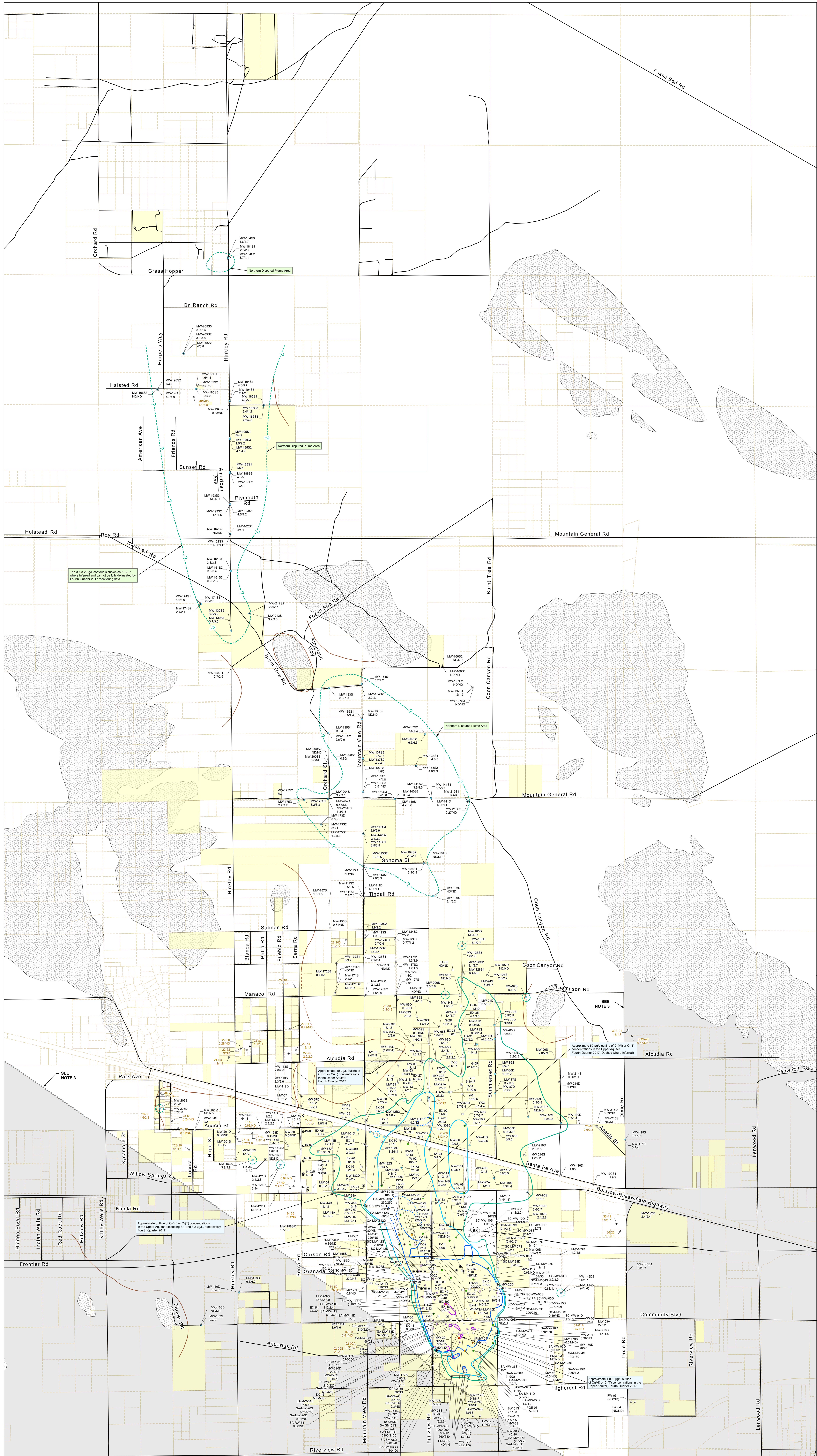
µg/L	Micrograms per Liter
Cr(VI)	Hexavalent Chromium
Cr(T)	Total Dissolved Chromium
J	Estimated Result
ND	Not Detected
NS	Not Sampled
PG&E	Pacific Gas and Electric Company

WORK CITED:
Arcadis. 2018. Fourth Quarter 2017 Monitoring Report for the In Situ Reactive Zone and Northwest Freshwater Injection Projects, Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California, California Regional Water Quality Control Board, Lahontan Region Order No. R5V-2008-0014 (Waste Discharge Requirements Identification No. 653699107001). January 30.
Stamos, C.L., P. Martin, T. Nishikawa, and B.F. Cox. 2001. *Simulation of Ground-Water Flow in the Mojave River, California*. U.S. Geological Survey Water-Resources Investigations Report 01-4002, Version 3. Prepared in cooperation with the Mojave Water Agency.

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FOURTH QUARTER 2017 GROUNDWATER MONITORING
REPORT AND DOMESTIC WELL RESULTS
SITE-WIDE GROUNDWATER MONITORING PROGRAM

PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA



LEGEND:

- Monitoring Well
- Domestic Supply Well (active and inactive)
- Other Supply Well
- Groundwater Extraction Well
- Multi-use Test Well, or Inactive Extraction/Injection Well
- Freewater Injection Well
- PG&E-Owned Property
- PG&E Compressor Station
- County Parcel
- Approximate Limit of Saturated Upper Aquifer
- Approximate Location of Locket Fault
- Fault Trace is Inferred, and There is No Surface Expression (Starnes et al. 2011)
- Bedrock Exposed at Ground Surface

Abbreviations:

µg/L Micrograms per Liter
Cr(VI) Hexavalent Chromium
Cr(III) Dissolved Chromium
Estimated Result
ND Not Detected
NS Not Sampled

MONITORING WELL DATA:

MW-1770 Well ID
1.61E Cr(VI)/Cr(III) concentrations in µg/L, maximum of primary and duplicate samples during Fourth Quarter 2017 sampling. Data in parentheses are from previous reporting period. See Table E-1 for sample dates.

GROUNDWATER Cr(VI) CONCENTRATIONS IN MONITORING WELLS:

- More than 1,000 µg/L
- 100 to 1,000 µg/L
- 10 to 100 µg/L
- 1 to 10 µg/L
- Less than 1 µg/L or ND

NOTES:

- Chromium results are shown for Site-wide Groundwater Monitoring Program and domestic wells sampled in the Fourth Quarter (October through December) 2017 monitoring period. For wells sampled multiple times during the reporting period, the most recent results are shown.
- The concentration contours are based on Fourth Quarter 2017 chromium results for the groundwater monitoring and extraction wells that are completed in the shallow zone and deep zone of the Upper Aquifer as noted on Figures 5-1 and 5-2. Results for domestic wells (down-colored labels) were not used for chromium plume contouring, except for those in the northern disputed plume areas, pursuant to the Lahontan Regional Water Quality Control Board's Cleanup and Abatement Order dated November 4, 2015 (Water Board 2015).
- Pursuant to the Lahontan Regional Water Quality Control Board's Cleanup and Abatement Order dated November 4, 2015 (Water Board 2015), groundwater monitoring wells are not used for chromium contouring if they are located in the areas southwest of the Locket Fault and on or east of Dixie Road. Monitoring wells sampled southwest of Locket Fault and east of Dixie Road were sampled in support of United States Geological Survey background chromium investigations.
- Chromium plume contours in the general area south of Highway 99, were developed using a target set of monitoring data which is presented in the Fourth Quarter 2017 Monitoring Report for the In Situ Reactive Zone and Northwest Freewater Injection Projects (Arcadis 2018). Select wells from that program are shown here for reference.

WORK CITED:

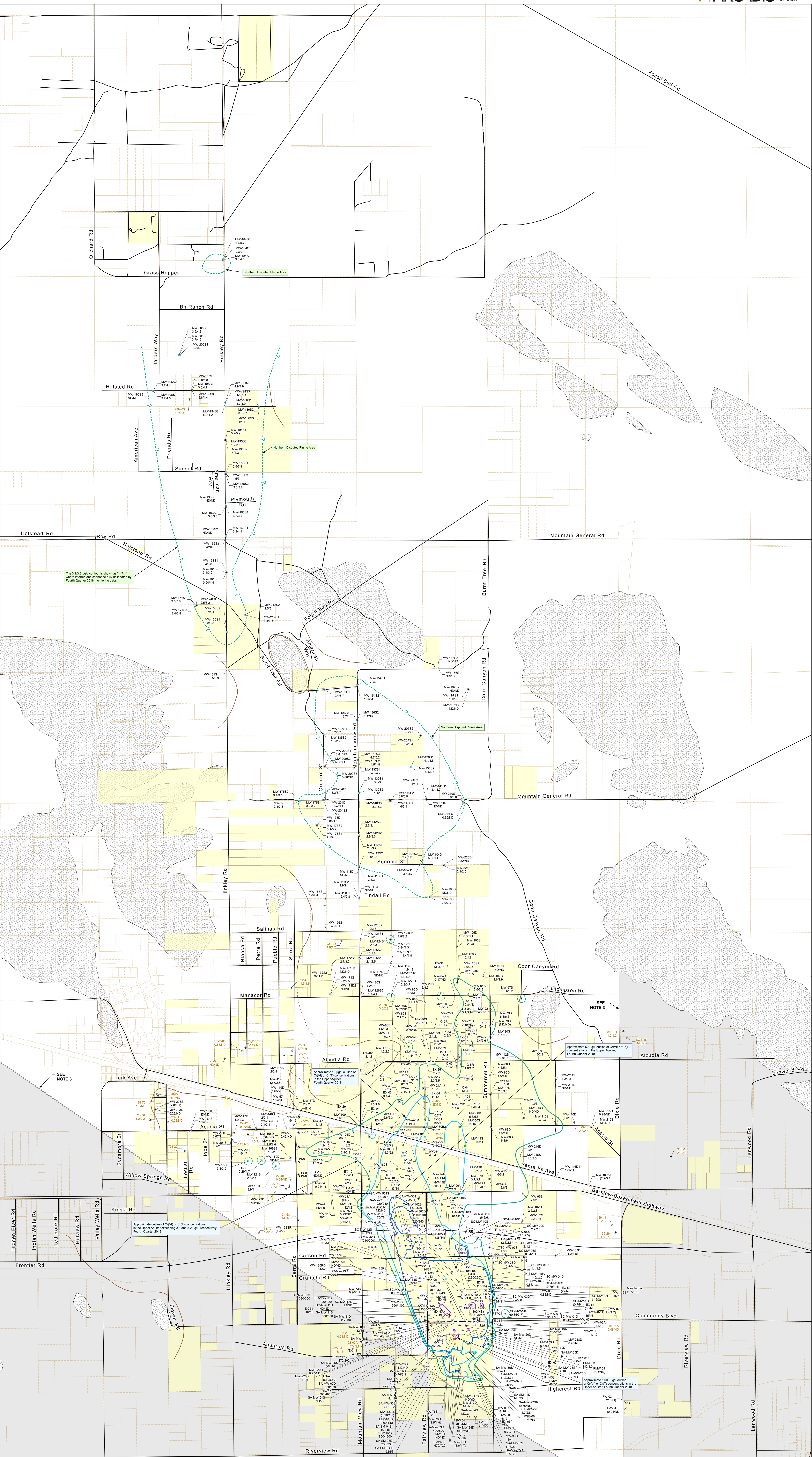
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FIGURE 5-2
CHROMIUM RESULTS FOR FOURTH QUARTER 2017
GROUNDWATER MONITORING AND DOMESTIC WELL
SAMPLING AND MAXIMUM COMPOSITE PLUME
OUTLINE IN UPPER AQUIFER

FOURTH QUARTER 2017 GROUNDWATER MONITORING REPORT AND DOMESTIC WELL RESULTS
SITE-WIDE GROUNDWATER MONITORING PROGRAM
PACIFIC GAS AND ELECTRIC COMPANY
HINKEY COMPRESSOR STATION
HINKEY, CALIFORNIA



LEGEND:

- Monitoring Well
- Domestic Supply Well (active and inactive)
- Other Supply Well
- Groundwater Extraction Well
- Multistage Test Well, or Inactive Extraction/Injection Well
- IRZ_INJ
- Freshwater Injection Well
- PG&E-Owned Property
- PG&E Compressor Station
- County Parcel
- Approximate Line of Saturated Alluvium Upper Aquifer
- Approximate Location of Lockhart Fault
- Fault Trace is Inferred, and There is No Surface Expression (Stanton et al. 2001)
- Bedrock Exposed at Ground Surface
- DRY Groundwater monitoring program well that has been dry for at least a year
- Location is Approximate, Survey Pending

SA-SM-015 Well ID
1501160 Cr(VI)/Cr(III) concentrations in µg/L, maximum of primary and duplicate samples during Fourth Quarter 2018 sampling. Data in parentheses are from previous reporting period. See Table E-1 for sample dates.

Groundwater Cr(VI) Concentrations in Monitoring Wells:

- More than 1,000 µg/L
- 100 to 1,000 µg/L
- 10 to 100 µg/L
- 3.1 to 10 µg/L
- Less than 3.1 µg/L or ND

ABBREVIATIONS:

- µg/L Micrograms per Liter
- Cr(VI) Hexavalent Chromium
- Cr(III) Total Dissolved Chromium
- Estimated Result
- ND Not Detected
- NS Not Sampled

NOTES:

- Chromium results are shown for Site-wide Groundwater Monitoring Program and domestic wells sampled in the Fourth Quarter (October through December) 2018 monitoring period. For wells sampled multiple times during the reporting period, the most recent results are shown.
- The concentration contours are based on Fourth Quarter 2018 chromium results for the groundwater monitoring and extraction wells that are completed in the shallow zone and deep zone of the Upper Aquifer as noted on Figures 5-1 and 5-2. Results for domestic wells (brown-colored labels) were not used for chromium plume contouring, except for those in the northern disputed plume areas, pursuant to the Lockhart Regional Water Quality Control Board's Cleanup and Abatement Order dated November 4, 2015 (Water Board 2015).
- Pursuant to the Lockhart Regional Water Quality Control Board's Cleanup and Abatement Order dated November 4, 2015 (Water Board 2015), groundwater monitoring wells are not used for chromium contouring if they are located in the areas southwest of the Lockhart Fault and on or east of Dixie Road. Monitoring wells sampled southwest of Lockhart Fault and east of Dixie Road were sampled in support of United States Geological Survey background chromium investigations.
- Chromium plume contours in the general area south of Highway 98, were developed using a larger set of monitoring data which is presented in the Fourth Quarter 2018 Monitoring Report for the In Situ Reactive Zone and Northwest Freshwater Injection Projects (Acosta 2019). Select wells from that program are shown here for reference.

WORK CITED:

Acosta. 2019. Fourth Quarter 2018 Monitoring Report for the In Situ Reactive Zone and Northwest Freshwater Injection Projects. Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California. California Regional Water Quality Control Board, Lahontan Region Order No. REV-2008-014 (Waste Discharge Requirements Identification No. 68369107001), January 30.

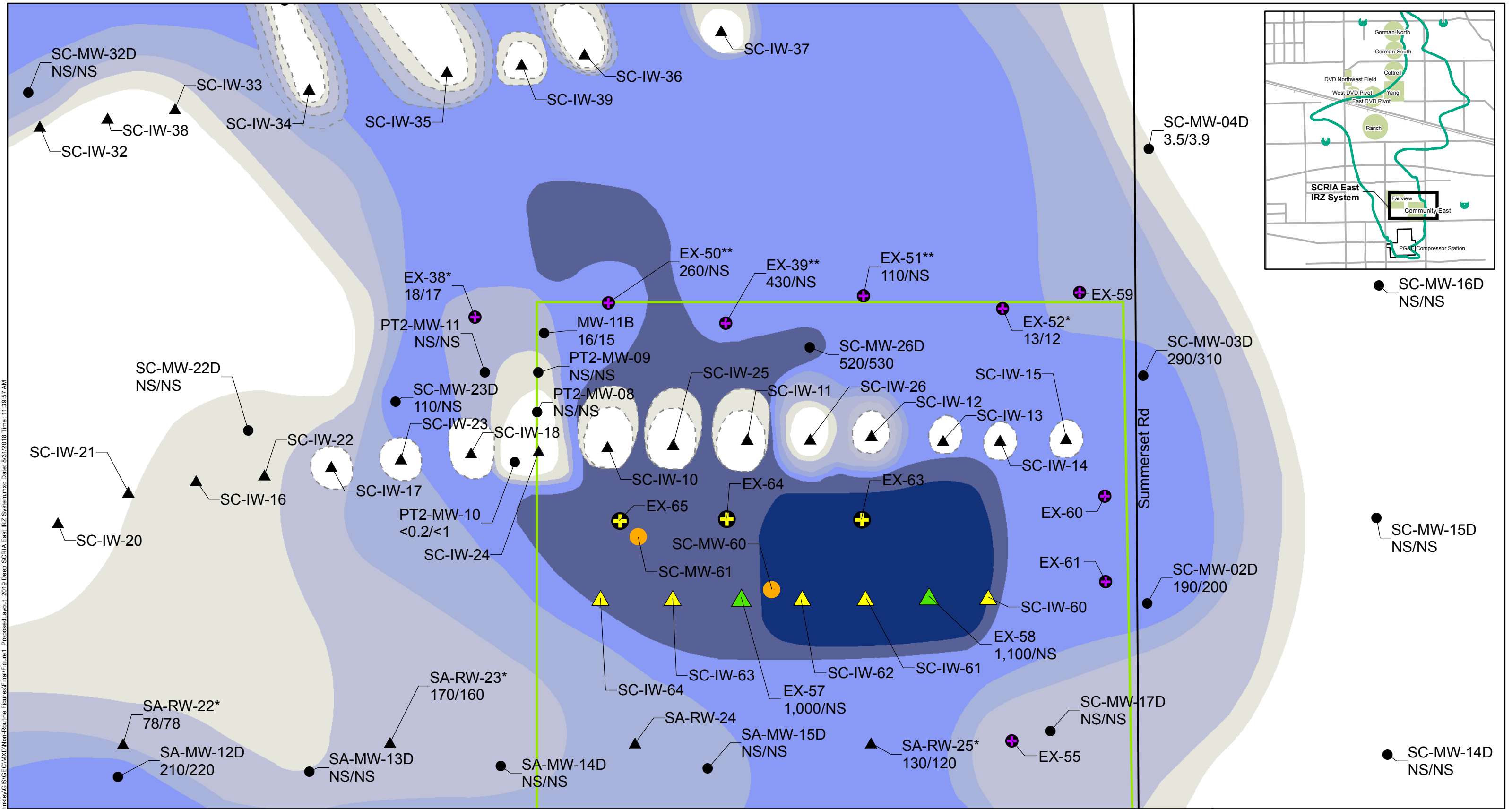
Stanton, C.L., P. Martin, N. Nakawaka, and B.F. Cox. 2001. Simulation of Ground Water Flow in the Mojave River Basin, California. U.S. Geological Survey Water-Resources Investigations Report 01-4002, Version 2.

Water Board. 2015. Cleanup and Abatement Order No. REV-2015-0068 Requiring Pacific Gas and Electric Company to Cleanup and Abate Waste Discharges of Total and Hexavalent Chromium to the Groundwaters of the Mojave Hydrologic Unit, November 4.

FIGURE 5-5 CHROMIUM RESULTS FOR FOURTH QUARTER 2018 GROUNDWATER MONITORING AND DOMESTIC WELL SAMPLING AND MAXIMUM COMPOSITE PLUME OUTLINE IN UPPER AQUIFER

FOURTH QUARTER 2018 GROUNDWATER MONITORING REPORT AND DOMESTIC WELL RESULTS
SITE-WIDE GROUNDWATER MONITORING PROGRAM
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA

Path: Z:\GIS\Projects\ENVR\000689\0001_PGE_Hinkley\GIS\GEC\MXD\Non-Routine Figures\Final\Figure1_Proposed Layout_2019 Deep SCRIA East IRZ System.mxd Date: 8/31/2018 Time: 11:39:57 AM



Legend

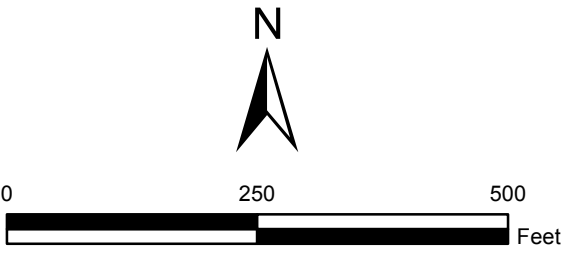
- Monitoring Well
- ⊕ Extraction Well
- ▲ IRZ Recirculation Well
- Proposed Monitoring Well
- ▲ Existing Extraction Well, will be completed as Injection Well
- ▲ Proposed Injection Well
- ▲ Proposed Extraction Well
- Community East ATU

MW-11B Well 16/15
Hexavalent Chromium/Total Dissolved Chromium Concentrations April, May, and June 2018

Approximate Outline of Cr(VI) or Cr(T) Concentrations in Shallow Zone of Upper Aquifer Exceeding Values of 3.1 and 3.2 µg/L, Respectively, Second Quarter 2018

- Chromium Concentrations Less than 3.1 µg/L
- Chromium Concentrations Between 3.1 and 10 µg/L
- Chromium Concentrations Between 10 and 50 µg/L
- Chromium Concentrations Between 50 and 100 µg/L
- Chromium Concentrations Between 100 and 500 µg/L
- Chromium Concentrations Between 500 and 1,000 µg/L
- Chromium Concentrations Equal to or Greater than 1,000 µg/L
- Inferred Concentration Contour

NOTES:
µg/L = Micrograms per Liter
IRZ = In Situ Reactive Zone
J = Estimated Result
NS = Not Sampled
< = Below Reporting Limit (as shown)
bgs = below ground surface
* Remedial wells screened across both shallow and deep zones of the upper aquifer; not used in contouring
** Depth discrete sample collected from the deep zone in 3Q 2017



**FIGURE 1
PROPOSED LAYOUT FOR DEEP
SCRIA EAST IRZ SYSTEM
(DEEP ZONE OF THE UPPER AQUIFER)**

PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA

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APPENDIX B

Mass Removal Estimates



MEMO

To:

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Lahontan Region (Water Board)
Shelby Barker, Amanda Lopez,
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From:

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Erika Carter, PhD
Jonathan Roller

Date:

March 20, 2020

Arcadis Project No.:

30035140.4Q19E

Subject:

Estimation of Chromium Mass Removal through Fourth Quarter 2019 Groundwater
Extraction and Agricultural Treatment and In Situ Reactive Zone Systems

INTRODUCTION

This technical memorandum provides estimates of the mass of hexavalent chromium (Cr[VI]) treated since 2004 using: (1) extraction and agricultural treatment and (2) In Situ Reactive Zone (IRZ) systems at the Pacific Gas and Electric Company (PG&E) Hinkley Compressor Station located in Hinkley, California (the site). Mass removal for remedial actions before 2004 at the historical Ranch and East Land Treatment Units were previously estimated (Alisto Engineering Group 2001). Since 2004, extraction and agricultural treatment has been implemented to remove Cr(VI) from the Upper Aquifer in the southern chromium plume north of Barstow-Bakersfield Highway. These systems include the Desert View Dairy (DVD) Agricultural Treatment Unit (ATU, formerly DVD Land Treatment Unit), Gorman ATU, Cottrell ATU, Yang ATU, and Ranch ATU. Beginning in 2015, the Community East ATU and Fairview ATU were put into operation south of Barstow-Bakersfield Highway. In that same area, three full-scale IRZ systems (Central Area, South Central ReInjection Area [SCRIA], and Source Area) have also been operated beginning in late 2007 to treat Cr(VI) in the Upper Aquifer. The northwest extraction wells that supply the southern systems have been operated since 2009.

This memorandum provides estimates of the mass of Cr(VI) removed by extraction and agricultural treatment since 2004 and by IRZ systems through the Fourth Quarter of 2019. The mass of Cr(VI) removed by extraction and agricultural treatment was calculated directly by multiplying the volume of extracted water discharged to the ATUs by the Cr(VI) concentration in the extracted water and assuming 100% treatment. The mass of Cr(VI) removed by IRZ treatment was determined based on the difference in the estimated Cr(VI) mass present in the Upper Aquifer groundwater in the IRZ area south of Barstow-Bakersfield Highway before full-scale IRZ operation (baseline) and at subsequent time steps following

Estimation of Chromium Mass Removal through Fourth Quarter 2019 Groundwater Extraction and Agricultural Treatment and In Situ Reactive Zone Systems

operation of the IRZs (i.e., Fourth Quarter of 2018 and Fourth Quarter of 2019). The Cr(VI) mass in the Upper Aquifer groundwater was estimated using the groundwater monitoring data and interpolated isoconcentration contours combined with estimated groundwater volumes. There is more uncertainty in the method for estimating the Cr(VI) mass treated by in situ technologies (i.e., IRZs) than estimates of Cr(VI) mass removed by extraction-based technologies (e.g., groundwater extraction and subsequent agricultural treatment), and additional uncertainty has been introduced due to declining water levels during the drought.

The methods used to calculate the Cr(VI) mass removed by extraction and agricultural treatment and estimate in situ Cr(VI) mass removal by IRZs were summarized in Appendix B to the Annual Cleanup Status and Effectiveness Report, January to December 2015 (Arcadis U.S., Inc. [Arcadis] 2016). Estimates of Cr(VI) mass in the subsurface presented in this memorandum were developed for the purpose of evaluating relative changes and mass removal by the IRZs over time and are not intended for, and would not be accurate for, evaluating the Cr(VI) released from the site.

CALCULATION OF HEXAVALENT CHROMIUM MASS REMOVED BY EXTRACTION AND AGRICULTURAL TREATMENT

Results of the Cr(VI) mass removal calculation for extraction and agricultural treatment since 2004 are presented in Table B-1. Since 2004, approximately 972 pounds of Cr(VI) have been removed by agricultural treatment, and an additional 79 pounds have been removed by northwest well extraction (100% treatment in IRZ assumed). Beginning in 2015, the startup of the Southern ATUs contributed significantly to agricultural treatment by expanding extraction to the plume core south of Barstow-Bakersfield Highway, with an estimated 413 pounds removed since 2015. In 2019, an estimated 27 pounds of Cr(VI) were removed by Northern ATUs, 104 pounds of Cr(VI) were removed by Southern ATUs, and approximately 12 pounds of Cr(VI) were removed by Northwest Area well extraction.

2019 DATA FOR CONTOURING-BASED MASS ESTIMATION

This section presents the data used to prepare 2019 Cr(VI) isoconcentration contours for the Upper Aquifer, both in the IRZ area south of Barstow-Bakersfield Highway and in the entire southern chromium plume north and south of Barstow-Bakersfield Highway.

Data Used to Estimate Cr(VI) Mass in the Upper Aquifer South of Barstow-Bakersfield Highway in the Fourth Quarter of 2019

Fourth Quarter of 2019 monitoring data were used to prepare isoconcentration contours of the Upper Aquifer Cr(VI) plume south of Barstow-Bakersfield Highway in the IRZ areas for Cr(VI) mass comparison to 2018 and baseline data. Third Quarter of 2019 data from several monitoring wells not sampled in the Fourth Quarter of 2019 were included to conservatively constrain the mass estimate. Fourth Quarter of 2019 isoconcentration contours were prepared for both the shallow and deep zones of the Upper Aquifer (Figures B-1 and B-2, respectively). The contours are consistent with those presented in the monitoring report prepared for the Fourth Quarter of 2019 (Arcadis 2020a). Data used for contouring are presented in Table B-2.

Data Used to Estimate Cr(VI) Mass in the Upper Aquifer in the Southern Chromium Plume North and South of Barstow-Bakersfield Highway in the Fourth Quarter of 2019

Fourth Quarter of 2019 monitoring data were also used to prepare isoconcentration contours of the entire southern chromium plume to estimate Cr(VI) mass remaining in the Upper Aquifer as of the Fourth Quarter of 2019. The corresponding isoconcentration contours were prepared for both the shallow and deep zones of the Upper Aquifer (Figures B-3 and B-4, respectively). The contours were prepared by combining the plumes south of Barstow-Bakersfield Highway for the shallow and deep zones of the Upper Aquifer south of Barstow-Bakersfield Highway (Figures B-3 and B-4, respectively), with the plume contours for the shallow and deep zones of the Upper Aquifer north of Barstow-Bakersfield Highway from the Fourth Quarter 2019 Groundwater Monitoring Program Report (GMP Report; Figures 5-1 and 5-2, respectively, from the GMP Report included in Appendix A; Arcadis 2019b). Data used for contouring are presented in Table B-2.

ESTIMATED HEXAVALENT CHROMIUM MASS REMOVED FROM GROUNDWATER BY IRZ SYSTEMS

The estimated Cr(VI) mass removed and mass remaining for the southern plume south of Barstow-Bakersfield Highway are presented in Tables B-3 and B-4. The mass removed by IRZ treatment was determined by comparing the mass remaining in the Fourth Quarter of 2019 to the Fourth Quarter of 2018 and baseline, and subtracting mass removed by the Southern ATUs (Table B-1) since operation began in 2015. The mass estimates historically used the distribution of concentrations combined with estimates of the area and thickness (i.e., volume) of the aquifer in a simple box model (modified for 2019 as discussed below). Estimates of mass removal during previous reporting periods assumed a total average saturated thickness of the Upper Aquifer of 60 feet, with three sublayers of the Upper Aquifer assigned thicknesses of 20 feet each (Table B-3). However, as discussed in Section 4 of the main report, groundwater levels have declined approximately 5 to 20 feet in the chromium plume core area outside the ATUs since 2012 due to the pervasive drought conditions. Therefore, the continued assumption of a total saturated thickness of 60 feet in the Upper Aquifer no longer reflects current conditions for mass removal and results in an overestimate of mass remaining and an underestimate of mass removed by the IRZs.

To address the uncertainty of estimating mass remaining and mass removed by the IRZ as water levels have declined, calculations were modified for 2019. As discussed above, the change in saturated thickness varies across the plume. Simplifying assumptions must be made to represent the change in the simple box model used for the mass estimate calculations. Instead, a hybrid approach to mass calculations was taken in 2019 to better incorporate the variation in saturated thickness across the plume due to the drought conditions. The simple box model was maintained for calculation of mass in the Layer 2 (intermittent brown clay) and Layer 3 (deep zone of the Upper Aquifer; Table B-3). For the shallow zone of the Upper Aquifer, Cr(VI) mass was calculated in the groundwater flow model for Model Layer 1 using the Fourth Quarter 2019 groundwater elevation surface to calculate variable saturated thickness in each cell, which was used in conjunction with Cr(VI) concentration to calculate the mass in each cell. In addition, the incorporation of Cr(VI) results for 2018 monitoring and remediation wells in the Deep SCRIA East added the equivalent of 136 pounds of Cr(VI) to the mass calculation estimates from previous years, which was added at the end of the calculation rather than modifying baseline contours.

Estimation of Chromium Mass Removal through Fourth Quarter 2019 Groundwater Extraction and Agricultural Treatment and In Situ Reactive Zone Systems

Operation of the Central Area, SCRIA, and Source Area IRZ systems from 2007 to 2019 has removed a significant amount of Cr(VI) from groundwater: approximately 2,881 pounds (equivalent to the 3,294 pounds removed from groundwater south of Barstow-Bakersfield Highway less the 413 pounds removed by Southern ATU extraction since 2015).

As described in the previous section, uncertainty exists in the values estimated for Cr(VI) mass present in the aquifer at a given time, while the computed percent mass removal provides a better indication of the magnitude of cleanup that has occurred to date.

ESTIMATED HEXAVALENT CHROMIUM MASS REMAINING IN THE SOUTHERN CHROMIUM PLUME IN FOURTH QUARTER OF 2018

Tables B-3 and B-4 also provide an estimate of the Cr(VI) mass remaining in the southern chromium plume (full plume) both north and south of Barstow-Bakersfield Highway (and generally south of Thompson Road) as of the Fourth Quarter of 2019. Approximately 1,683 pounds of Cr(VI) were estimated to remain in the Upper Aquifer south of Barstow-Bakersfield Highway, and 205 pounds in the Upper Aquifer north of Barstow-Bakersfield Highway, for a total of 1,888 pounds at the end of the Fourth Quarter of 2019.

SUMMARY

Since 2004, the beneficial use of groundwater for agricultural operations at Hinkley has removed approximately 1,050 pounds of Cr(VI) from the Upper Aquifer while generating thousands of bales of alfalfa and other fodder crops. Northern ATUs have removed a total of approximately 559 pounds of Cr(VI), and Southern ATUs in operation since May 2015 have removed approximately 413 pounds of Cr(VI). Groundwater extraction from the Northwest Area wells and conveyance south of Barstow-Bakersfield Highway for IRZ treatment has removed approximately 79 pounds of Cr(VI) from the Upper Aquifer. In 2019, the ATUs removed approximately 130 pounds of Cr(VI), and Northwest Area wells removed approximately 12 pounds of Cr(VI).

In situ treatment has provided rapid treatment where applied in the plume core south of Barstow-Bakersfield Highway. Results of mass removal estimations indicate that operation of the Central Area, SCRIA, and Source Area IRZ systems from 2007 to 2019 has removed an estimated 2,881 pounds of Cr(VI). In 2019, an estimated 348 pounds of Cr(VI) was removed by the IRZ systems.

Approximately 1,683 pounds of Cr(VI) was estimated to remain in the Upper Aquifer south of Barstow-Bakersfield Highway and 205 pounds in the Upper Aquifer north of Barstow-Bakersfield Highway, for a total of 1,888 pounds at the end of the Fourth Quarter of 2019.

REFERENCES

- Alisto Engineering Group. 2001. Annual Report Evaluation of Corrective Action for Year 2000-2001, Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California. June.
- Arcadis. 2016. Annual Cleanup Status and Effectiveness Report, January to December 2015. Hinkley Compressor Station, Hinkley, California. February 26.
- Arcadis. 2020a. Fourth Quarter 2019 Monitoring Report for the In Situ Reactive Zone and Northwest Freshwater Injection Projects. January 30.

Estimation of Chromium Mass Removal through Fourth Quarter 2019 Groundwater Extraction and Agricultural Treatment and In Situ Reactive Zone Systems

Arcadis. 2020b. Fourth Quarter of 2019 Groundwater Monitoring Report and Domestic Well Sampling Results. Site-wide Groundwater Monitoring Program. Hinkley Compressor Station, Hinkley, California. February 10.

ATTACHMENTS

Tables

Table B-1	Cumulative Pounds of Hexavalent Chromium Removed Versus Cumulative Gallons Extracted
Table B-2	Monitoring Well Data Used in Calculation of Fourth Quarter 2019 Hexavalent Chromium Mass for the Upper Aquifer, Southern Chromium Plume
Table B-3	Estimation of Hexavalent Chromium Mass for Southern Chromium Plume, 2007 – 2019

Figures

Figure B-1	IRZ Area Total Dissolved Chromium and Hexavalent Chromium Concentrations (Shallow Zone of the Upper Aquifer) Fourth Quarter 2019
Figure B-2	IRZ Area Total Dissolved Chromium and Hexavalent Chromium Concentrations (Deep Zone of the Upper Aquifer) Fourth Quarter 2019
Figure B-3	Fourth Quarter 2019 Hexavalent Chromium Isoconcentration Contours in the Shallow Zone of the Upper Aquifer, Southern Chromium Plume
Figure B-4	Fourth Quarter 2019 Hexavalent Chromium Isoconcentration Contours in the Deep Zone of the Upper Aquifer, Southern Chromium Plume

TABLES



Table B-1
Cumulative Pounds of Hexavalent Chromium Removed Versus Cumulative Gallons Extracted
Estimation of Chromium Mass Removal through Fourth Quarter 2018
Four Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Quarterly Operation Period	DVD-LTU Wells ¹		Northern AU Wells ²		DVD Optimization Wells ³		Northwest Wells ⁴	
	Total Volume Extracted (gallons)	Pounds Cr(VI) Removed	Total Volume Extracted (gallons)	Pounds Cr(VI) Removed	Total Volume Extracted (gallons)	Pounds Cr(VI) Removed	Total Volume Extracted	Pounds Cr(VI) Removed
Q4-2004 ⁵	10,642,999	4.46	--	--	--	--	--	--
Q1-2005	25,633,643	6.40	--	--	--	--	--	--
Q2-2005	29,312,673	5.68	--	--	--	--	--	--
Q3-2005	45,251,482	6.90	--	--	--	--	--	--
Q4-2005	27,808,140	4.08	--	--	--	--	--	--
Q1-2006	34,816,728	5.28	--	--	--	--	--	--
Q2-2006	36,022,136	4.83	--	--	--	--	--	--
Q3-2006	30,460,324	4.44	--	--	--	--	--	--
Q4-2006	34,979,675	5.16	--	--	--	--	--	--
Q1-2007	24,607,191	3.74	--	--	--	--	--	--
Q2-2007	35,807,194	5.40	--	--	--	--	--	--
Q3-2007	57,801,470	8.45	--	--	--	--	--	--
Q4-2007	27,414,012	3.88	--	--	--	--	--	--
Q1-2008	34,477,266	4.75	--	--	--	--	--	--
Q2-2008	37,766,595	5.21	--	--	2,574,685	1.19	--	--
Q3-2008	50,248,258	6.77	--	--	9,126,127	3.68	--	--
Q4-2008	28,842,091	3.82	--	--	8,550,310	3.22	--	--
Q1-2009	16,750,633	2.35	--	--	3,976,423	1.50	--	--
Q2-2009	38,762,406	5.43	--	--	11,149,707	4.29	--	--
Q3-2009	45,580,668	5.82	--	--	9,827,855	3.62	--	--
Q4-2009	24,846,973	3.34	--	--	912,911	0.27	5,572,728	1.58

Table B-1
Cumulative Pounds of Hexavalent Chromium Removed Versus Cumulative Gallons Extracted
Estimation of Chromium Mass Removal through Fourth Quarter 2018
Four Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Quarterly Operation Period	DVD-LTU Wells ¹		Northern AU Wells ²		DVD Optimization Wells ³		Northwest Wells ⁴	
	Total Volume Extracted (gallons)	Pounds Cr(VI) Removed	Total Volume Extracted (gallons)	Pounds Cr(VI) Removed	Total Volume Extracted (gallons)	Pounds Cr(VI) Removed	Total Volume Extracted	Pounds Cr(VI) Removed
Q1-2010	28,868,341	3.54	--	--	0	0	12,984,931	4.07
Q2-2010	50,003,911	5.95	--	--	0	0	12,934,660	4.67
Q3-2010	63,551,479	8.41	--	--	0	0	13,263,459	5.03
Q4-2010	52,990,005	5.56	--	--	0	0	13,208,323	4.83
Q1-2011	33,759,124	4.09	7,434,327	0.21	0	0	11,129,648	2.83
Q2-2011	51,351,653	5.30	56,483,061	2.93	0	0	8,378,997	2.04
Q3-2011	76,600,901	9.37	74,886,739	4.76	0	0	9,116,067	2.11
Q4-2011	57,555,693	7.98	53,272,348	3.77	0	0	9,169,416	2.09
Q1-2012	43,669,932	6.77	63,146,073	3.23	0	0	8,457,278	2.10
Q2-2012	64,958,612	8.28	95,442,060	7.76	0	0	8,593,765	2.39
Q3-2012	68,365,663	7.87	98,572,346	9.97	0	0	7,308,606	1.30
Q4-2012	70,303,853	7.85	87,006,168	7.87	0	0	6,994,726	1.38
Q1-2013	51,385,802	5.03	69,839,718	5.36	0	0	6,435,935	2.10
Q2-2013	57,939,081	5.51	94,409,477	8.07	0	0	5,771,338	2.25
Q3-2013	68,263,643	6.16	105,658,060	9.82	0	0	6,744,021	2.30
Q4-2013	57,255,030	6.65	79,536,683	7.10	0	0	5,808,885	1.98
Q1-2014	54,901,717	6.14	64,215,724	4.68	0	0	7,690,860	1.99

Table B-1
Cumulative Pounds of Hexavalent Chromium Removed Versus Cumulative Gallons Extracted
Estimation of Chromium Mass Removal through Fourth Quarter 2018
Four Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Quarterly Operation Period	Agricultural Treatment Units						Northwest Wells	
	Northern ATUs ⁶		Southern ATUs ⁷		TOTAL ATUs			
	Total Volume Extracted (gallons)	Pounds Cr(VI) Removed	Total Volume Extracted (gallons)	Pounds Cr(VI) Removed	Total Volume Extracted (gallons)	Pounds Cr(VI) Removed	Total Volume Extracted (gallons)	Pounds Cr(VI) Removed
Q2-2014	151,372,966	14.90	0	0	151,372,966	14.90	8,595,500	1.25
Q3-2014	177,855,669	15.28	0	0	177,855,669	15.28	7,187,586	1.11
Q4-2014	123,234,926	9.95	0	0	123,234,926	9.95	7,339,480	1.17
Q1-2015	74,581,611	10.27	0	0	74,581,611	10.27	8,705,840	0.67
Q2-2015	129,810,798	14.62	8,519,100	5.47	138,329,898	20.09	8,576,100	0.53
Q3-2015	149,707,248	16.04	36,426,200	42.78	186,133,448	58.82	7,848,490	0.41
Q4-2015	98,769,810	11.35	30,873,300	40.94	129,643,110	52.29	7,724,780	0.35
Q1-2016	92,693,542	12.12	24,769,000	19.05	117,462,542	31.17	8,267,880	0.35
Q2-2016	132,424,486	13.43	42,150,146	32.12	174,574,632	45.56	8,538,152	0.42
Q3-2016	156,071,587	14.10	45,603,095	30.59	201,674,682	44.69	9,451,270	0.55
Q4-2016	105,230,453	10.57	22,752,249	12.15	127,982,702	22.72	9,407,458	0.58
Q1 2017	83,191,639	7.79	14,351,748	7.95	97,543,387	15.74	7,446,080	0.54
Q2 2017	130,160,498	10.74	42,296,746	20.18	172,457,244	30.91	9,175,378	0.28
Q3 2017	149,837,869	15.13	49,599,045	25.41	199,436,914	40.54	7,540,723	0.96
Q4 2017	96,127,570	7.99	28,137,546	14.41	124,265,116	22.39	6,584,101	1.28
Q1 2018 ⁸	88,168,734	7.52	13,675,850	6.38	101,844,584	13.91	6,732,880	3.30
Q2 2018 ⁸	126,607,160	10.36	41,376,145	19.00	167,983,305	29.36	6,212,786	3.53
Q3 2018 ⁸	150,301,487	13.24	55,546,495	19.94	205,847,982	33.18	4,340,558	1.57
Q4 2018 ⁸	97,937,382	7.33	34,417,047	12.84	132,354,429	20.17	1,942,696	1.26
Q1 2019 ⁸	86,225,084	5.82	21,754,092	14.71	107,979,176	20.53	14,411,616	1.95
Q2 2019 ⁸	131,476,803	8.28	48,100,795	29.91	179,577,598	38.20	27,881,120	3.46
Q3 2019 ⁸	160,219,768	8.37	51,611,195	43.10	211,830,963	51.47	28,664,960	3.61
Q4 2019 ⁹	86,652,346	4.46	28,900,497	15.81	115,552,843	20.27	26,892,320	2.89
2019	464,574,000	27	150,366,579	104	614,940,579	130	97,850,016	12
Cumulative	5,424,237,236	560	1,750,326,718	413	3,567,237,286	972	399,031,397	79

Notes:

¹ As of March 17 2014, the DVD is permitted as an ATU, and is considered one of the Northern ATUs. Reporting under the Waste Discharge Requirements for ATUs began in April 2014.

² Northern AU wells supplied the Gorman, Cottrell, Ranch, and Yang AUs prior to issuance of Waste Discharge Requirements for ATUs in 2014.

³ Optimization wells included EX-15, EX-16, and EX-20, and extracted water supplemented the DVD-LTU wells in 2008 - 2009.

⁴ Northwest extraction wells are connected to the South Central Reinjection Area In Situ Reactive Zone system and consist of wells EX-05, EX-15, EX-16, EX-20, EX-21, EX-22.

⁵ The Fourth Quarter of 2004 extraction totals include September 2004 extraction and Cr(VI) data for DVD well EX-01.

⁶ The following ATUs are located north of Highway 58 and are considered Northern ATUs: DVD, Gorman, Cottrell, Ranch, and Yang ATUs.

⁷ Community East ATU and Fairview ATU are located south of Highway 58 and are considered Southern ATUs.

⁸ Groundwater extracted from the NW Area Wells (EX-05, EX-15, EX-16, EX-20, EX-22, and EX-53) conveyed South for IRZ treatment.

-- = not applicable

ATU = Agricultural Treatment Unit

Cr(VI) = hexavalent chromium

AU = Agricultural Unit

DVD-LTU = Desert View Dairy Land Treatment Unit

Table B-2

Monitoring Well Data Used in Calculation of Fourth Quarter 2019 Hexavalent Chromium Mass for the Upper Aquifer, Southern Chromium Plume
 Estimation of Chromium Mass Removal through Fourth Quarter 2019
 Four Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
 Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Well Location	Sample Date	Cr(VI) Concentration (µg/L)
BW-01D	10/21/2019	3.4
BW-01S	10/21/2019	2.6
CA-MW-101D	11/4/2019	ND (<0.2)
CA-MW-102D	7/10/2019	ND (<0.2)
CA-MW-103D	7/10/2019	ND (<0.2)
CA-MW-104D	7/10/2019	ND (<0.2)
CA-MW-104S	7/11/2019	ND (<0.2)
CA-MW-105D	7/11/2019	2.9
CA-MW-105R	7/11/2019	ND (<0.2)
CA-MW-106D	7/11/2019	ND (<0.2)
CA-MW-107D	11/4/2019	ND (<0.2)
CA-MW-107S	9/5/2019	ND (<0.2)
CA-MW-108D	11/4/2019	ND (<0.2)
CA-MW-108S	7/15/2019	ND (<0.2)
CA-MW-109D	11/4/2019	ND (<0.2)
CA-MW-110	10/22/2019	ND (<0.2)
CA-MW-201	7/11/2019	ND (<0.2)
CA-MW-202	7/11/2019	ND (<0.2)
CA-MW-203	7/11/2019	ND (<0.2)
CA-MW-204D	7/11/2019	0.51
CA-MW-302D	7/12/2019	120
CA-MW-303D	7/12/2019	17
CA-MW-304	7/12/2019	6.2
CA-MW-305	7/12/2019	0.28
CA-MW-306D	7/12/2019	73
CA-MW-307D	7/12/2019	ND (<0.2)
CA-MW-307S	7/12/2019	ND (<0.2)
CA-MW-309	7/12/2019	0.31
CA-MW-310D	7/17/2019	0.21
CA-MW-310S	7/18/2019	0.91
CA-MW-311	7/17/2019	ND (<0.2)
CA-MW-312D	11/4/2019	39
CA-MW-313R	11/4/2019	190
CA-MW-314	7/17/2019	ND (<0.2)
CA-MW-315D	7/12/2019	64
CA-MW-315S	7/12/2019	2.6
CA-MW-316	7/12/2019	5
CA-MW-317D	7/12/2019	7.1
CA-MW-317S	7/12/2019	1.7
CA-MW-401	7/12/2019	110
CA-MW-402D	7/12/2019	ND (<0.2)
CA-MW-402S	7/12/2019	57
CA-MW-403D	7/12/2019	ND (<0.2)
CA-MW-403S	7/12/2019	8.4
CA-MW-404D	7/15/2019	ND (<0.2)
CA-MW-404S	7/15/2019	3.5
CA-MW-405D	7/15/2019	30
CA-MW-406	7/17/2019	ND (<0.2)
CA-MW-407	7/15/2019	ND (<0.2)
CA-MW-408	7/15/2019	ND (<0.2)
CA-MW-409D	7/15/2019	ND (<0.2)
CA-MW-409D	7/15/2019	ND (<0.2)
CA-MW-410	7/15/2019	ND (<0.2)
CA-MW-411D	7/15/2019	ND (<0.2)
CA-MW-411S	7/15/2019	0.28
CA-MW-412D	11/5/2019	76
CA-MW-412D2	11/4/2019	ND (<0.2)
CA-MW-502	7/18/2019	3.3
CA-MW-503D	7/17/2019	2.8
CA-MW-505	7/22/2019	6.7
CA-MW-506D	7/22/2019	32

Table B-2

Monitoring Well Data Used in Calculation of Fourth Quarter 2019 Hexavalent Chromium Mass for the Upper Aquifer, Southern Chromium Plume
 Estimation of Chromium Mass Removal through Fourth Quarter 2019
 Four Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
 Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Well Location	Sample Date	Cr(VI) Concentration (µg/L)
CA-MW-506S	11/5/2019	12
CA-MW-507	7/22/2019	0.25
CA-MW-508D	8/5/2019	17
CA-MW-508S	8/5/2019	ND (<0.2)
CA-MW-509	8/5/2019	1.2
CA-MW-511	11/6/2019	1.9
CA-MW-601	11/6/2019	44
CA-MW-602	11/6/2019	6.9
CA-MW-603	11/6/2019	4
EX-15	10/17/2019	1.1
EX-17	10/25/2019	ND (<0.2)
EX-17	10/25/2019	ND (<0.2)
EX-21	10/18/2019	ND (<0.2)
EX-21	10/18/2019	ND (<0.2)
EX-56	10/15/2019	12
EX-59	10/15/2019	31
EX-65	10/17/2019	40
EX-67	11/7/2019	24
EX-67	11/7/2019	24
MW-01	10/23/2019	ND (<0.2)
MW-03	10/24/2019	16
MW-06	7/11/2019	1.1
MW-10	10/24/2019	8.9
MW-108D	10/18/2019	3.4
MW-108D	10/18/2019	3.4
MW-11B	11/8/2019	59
MW-12B	7/17/2019	4.7
MW-13	7/17/2019	1.6
MW-14A	8/5/2019	1.6
MW-14B	10/22/2019	23
MW-15	10/24/2019	290
MW-155D	11/8/2019	ND (<0.2)
MW-155S	11/8/2019	1.3
MW-17	11/6/2019	76
MW-177D	11/6/2019	1.4
MW-177S	11/6/2019	0.8
MW-178D	11/6/2019	45
MW-178S	10/22/2019	84
MW-179D	11/6/2019	24
MW-17D	7/11/2019	3
MW-18	7/11/2019	5
MW-180RD	11/6/2019	6.7
MW-180RS	11/6/2019	1.7
MW-181D	7/12/2019	1.1
MW-181S	7/12/2019	0.82
MW-182D	11/6/2019	2.4
MW-182S	11/6/2019	4
MW-183D	11/6/2019	4.6
MW-183S	11/6/2019	2.6
MW-20	10/24/2019	ND (<0.2)
MW-208S	10/21/2019	710
MW-209S	10/21/2019	43
MW-210S	10/21/2019	29
MW-211S	10/21/2019	3
MW-213D	10/15/2019	ND (<0.2)
MW-213S	10/15/2019	3.3
MW-214D	10/15/2019	ND (<0.2)
MW-214S	10/15/2019	2.9
MW-217D	10/24/2019	ND (<0.2)
MW-217S	10/24/2019	0.97
MW-218D	10/24/2019	0.43

Table B-2

Monitoring Well Data Used in Calculation of Fourth Quarter 2019 Hexavalent Chromium Mass for the Upper Aquifer, Southern Chromium Plume
 Estimation of Chromium Mass Removal through Fourth Quarter 2019
 Four Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
 Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Well Location	Sample Date	Cr(VI) Concentration (µg/L)
MW-218S	10/24/2019	0.91
MW-220D	10/7/2019	0.35
MW-22B	10/18/2019	8.1
MW-27A	10/22/2019	10
MW-27B	10/22/2019	5.9
MW-28B	10/18/2019	2
MW-36	11/6/2019	9.1
MW-37	11/6/2019	0.67
MW-38B	11/6/2019	7.1
MW-39	7/11/2019	ND (<0.2)
MW-39D	11/7/2019	ND (<0.2)
MW-44B	10/21/2019	1.3
MW-45A	10/24/2019	1
MW-45B	10/24/2019	1.2
MW-46M	11/6/2019	0.64
MW-49A	10/24/2019	4.6
MW-49S	10/24/2019	4
MW-52	10/22/2019	2.3
MW-54	10/25/2019	0.88
MW-67B	11/6/2019	0.4
MW-73D	11/7/2019	0.92
MW-73D	11/7/2019	0.92
MW-75D	11/6/2019	0.28
MW-76S	10/25/2019	1.2
MW-78D	7/11/2019	1.6
MW-78S	11/7/2019	0.78
PMW-01	10/23/2019	ND (<0.2)
PMW-02	10/23/2019	560
PMW-03	10/23/2019	ND (<0.2)
PMW-04	7/24/2019	ND (<0.2)
PMW-06	7/25/2019	ND (<0.2)
PT1-MW-01	7/24/2019	ND (<0.2)
PT1-MW-04	11/7/2019	400
PT2-MW-08	7/24/2019	ND (<0.2)
PT2-MW-09	7/24/2019	ND (<0.2)
PT2-MW-10	11/7/2019	ND (<0.2)
PT2-MW-11	7/24/2019	0.33
SA-MW-01D	7/16/2019	22
SA-MW-01S	11/5/2019	2.6
SA-MW-02D	7/16/2019	ND (<0.2)
SA-MW-03D	7/16/2019	ND (<0.2)
SA-MW-03S	7/16/2019	ND (<0.2)
SA-MW-04D	7/16/2019	ND (<0.2)
SA-MW-04S	11/7/2019	ND
SA-MW-05D	11/4/2019	320
SA-MW-05S	7/25/2019	ND (<0.2)
SA-MW-06D	7/23/2019	260
SA-MW-06S	11/7/2019	110
SA-MW-07D	11/7/2019	420
SA-MW-08D	11/7/2019	200
SA-MW-08S	7/24/2019	42
SA-MW-09D	7/25/2019	ND (<0.2)
SA-MW-10D	11/7/2019	480
SA-MW-10S	7/26/2019	ND (<0.2)
SA-MW-11S	11/5/2019	470
SA-MW-12D	11/7/2019	180
SA-MW-13D	7/18/2019	7
SA-MW-13S	11/7/2019	2400
SA-MW-14D	7/17/2019	53
SA-MW-15D	7/17/2019	63
SA-MW-16D	11/7/2019	0.92

Table B-2

Monitoring Well Data Used in Calculation of Fourth Quarter 2019 Hexavalent Chromium Mass for the Upper Aquifer, Southern Chromium Plume
 Estimation of Chromium Mass Removal through Fourth Quarter 2019
 Four Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
 Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Well Location	Sample Date	Cr(VI) Concentration (µg/L)
SA-MW-16S	11/7/2019	110
SA-MW-17D	7/16/2019	0.83
SA-MW-17S	11/5/2019	300
SA-MW-18S	11/5/2019	260
SA-MW-20D	11/7/2019	ND (<0.2)
SA-MW-20S	7/26/2019	ND (<0.2)
SA-MW-21D	7/18/2019	0.87
SA-MW-21S	7/18/2019	ND (<0.2)
SA-MW-22D	7/18/2019	ND (<0.2)
SA-MW-23D	11/7/2019	20
SA-MW-23S	11/7/2019	39
SA-MW-24D	7/22/2019	15
SA-MW-25D	11/7/2019	0.72
SA-MW-25S	11/7/2019	0.48
SA-MW-26D	11/6/2019	0.6
SA-MW-26S	11/5/2019	ND (<0.2)
SA-MW-27D	11/7/2019	ND (<0.2)
SA-MW-28D	11/7/2019	2.5
SA-MW-29D	7/18/2019	ND (<0.2)
SA-MW-29D	7/18/2019	ND (<0.2)
SA-MW-30D	11/7/2019	150
SA-MW-30S	7/26/2019	ND (<0.2)
SA-MW-31S	7/26/2019	ND (<0.2)
SA-MW-32S	7/26/2019	ND (<0.2)
SA-MW-33S	7/26/2019	18
SA-MW-34D	7/22/2019	0.77
SA-MW-34S	11/7/2019	28
SA-MW-35D	7/24/2019	15
SA-MW-35S	7/24/2019	0.43
SA-MW-36D	7/23/2019	2.8
SA-MW-36S	11/7/2019	ND (<0.2)
SA-MW-37D	11/4/2019	5.2
SA-MW-38S	11/4/2019	130
SA-MW-39D	11/4/2019	290
SA-MW-40D	11/4/2019	0.93
SA-MW-40S	11/4/2019	120
SA-MW-41	11/8/2019	ND (<0.2)
SA-MW-43M	11/8/2019	1000
SA-MW-43S	11/8/2019	1000
SA-MW-44D	11/8/2019	700
SA-MW-44S	11/8/2019	0.53
SA-RW-25	11/8/2019	89
SA-SM-01D	11/6/2019	ND (<0.2)

Table B-3

Estimation of Hexavalent Chromium Mass for Southern Chromium Plume, 2007 - 2019
 Estimation of Chromium Mass Removal through Fourth Quarter 2019
 Four Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
 Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Southern Chromium Plume South of Barstow-Bakersfield Highway

Time = Baseline Plume

	Model Layer 1 - Upper UAU	Model Layer 2 - Intermittent Brown Clay	Model Layer 3 - Lower UAU	Total UAU (Model Layers 1, 2, & 3)
Southern Plume South of Barstow-Bakersfield Highway				
Average Saturated Thickness (ft)	20	20	20	
Interpolated Mobile Grid Cr(VI) Concentration x Area (ft ² *µg/L) ¹	2.59E+09	2.83E+09	2.83E+09	
Mobile Porosity	7%	7%	7%	
Computed Mobile Mass (kg)	103	112	112	327
Interpolated Immobile Grid Cr(VI) Concentration x Area (ft ² *µg/L) ²	3.85E+09	3.98E+09	3.98E+09	
Immobile Porosity	28%	28%	28%	
Computed Immobile Mass (kg)	611	631	631	1,873
			Total Mass (kg) =	2,200
			pounds =	4,841

Time = 4Q 2018 Plume

	Model Layer 1 - Upper UAU	Model Layer 2 - Intermittent Brown Clay	Model Layer 3 - Lower UAU	Total UAU (Model Layers 1, 2, & 3)
Southern Plume South of Barstow-Bakersfield Highway				
Average Saturated Thickness (ft)	20	20	20	
Interpolated Mobile Grid Cr(VI) Concentration x Area (ft ² *µg/L)	1.49E+09	1.37E+09	1.37E+09	
Mobile Porosity	7%	7%	7%	
Computed Mobile Mass (kg)	59	54	54	168
Interpolated Immobile Grid Cr(VI) Concentration x Area (ft ² *µg/L)	1.97E+09	1.54E+09	1.54E+09	
Immobile Porosity	28%	28%	28%	
Computed Immobile Mass (kg)	313	245	245	803
			Total Mass (kg) =	970
			pounds =	2,135

Time = 4Q 2019 Plume

	Model Layer 1 - Upper UAU	Model Layer 2 - Intermittent Brown Clay	Model Layer 3 - Lower UAU	Total UAU (Model Layers 1, 2, & 3)
Full Continuous Plume				
Average Saturated Thickness (ft) ⁴	Variable ⁴	20	20	
Interpolated Mobile Grid Cr(VI) Concentration x Area (ft ² *µg/L)	N/A	1.09E+09	1.09E+09	
Mobile Porosity	N/A	7%	7%	
Computed Mobile Mass (kg) ⁴	40	43	43	126
Interpolated Immobile Grid Cr(VI) Concentration x Area (ft ² *µg/L)	N/A	1.31E+09	1.31E+09	
Immobile Porosity	N/A	28%	28%	
Computed Immobile Mass (kg) ⁴	224	207	207	639
			Total Mass (kg) =	765
			pounds =	1,683

Table B-3

Estimation of Hexavalent Chromium Mass for Southern Chromium Plume, 2007 - 2019
 Estimation of Chromium Mass Removal through Fourth Quarter 2019
 Four Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
 Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Southern Chromium Plume (Full Continuous Plume)

Time = 4Q 2019 Plume

	Model Layer 1 - Upper UAU	Model Layer 2 - Intermittent Brown Clay	Model Layer 3 - Lower UAU	Total UAU (Model Layers 1, 2, & 3)
Full Continuous Plume				
Average Saturated Thickness (ft) ⁴	Variable ⁴	20	20	
Interpolated Mobile Grid Cr(VI) Concentration x Area (ft ² *µg/L)	N/A	1.18E+09	1.18E+09	
Mobile Porosity	N/A	7%	7%	
Computed Mobile Mass (kg) ⁴	51	47	47	145
Interpolated Immobile Grid Cr(VI) Concentration x Area (ft ² *µg/L)	N/A	1.40E+09	1.40E+09	
Immobile Porosity	N/A	28%	28%	
Computed Immobile Mass (kg) ⁴	270	222	222	714
			Total Mass (kg) =	858
			pounds =	1,888

Summary
Southern Chromium Plume South of Barstow-Bakersfield Highway

Cr(VI) Mass Removed from Groundwater 2018 - 2019

 205 kg
 452 pounds
Cumulative Cr(VI) Mass Removed from Groundwater 2007 - 2019³
 1366 kg
 2842 pounds
 65%

Southern Chromium Plume (Full Continuous Plume)

Total Cr(VI) Mass Remaining 2019

 858 kg
 1888 pounds

North of Highway 58

 93 kg
 205 pounds

South of Highway 58

 765 kg
 1683 pounds

Notes:

¹ Concentration x Area are computed by first krigging the point concentration and interpreted contours and computing the concentration x area through the cut fill method of all concentrations greater than 3.1. This creates a mixed unit volume of concentration x square foot that can be utilized to compute mass.

² Immobile grid volume assumes double the concentration in areas where baseline groundwater chromium concentrations exceeded 500 µg/L to reflect additional source area mass in the immobile phase that has persisted over time.

³ Adjusted for 136 pounds estimated in Deep SCRIA East in 2018 with new delineation

⁴ Due to high spatial variability in aquifer thickness in Model Layer 1 due to drought and pumping on site, mass was calculated on grid basis using variable saturated thickness based on 2019 water levels.

Cr(VI) = hexavalent chromium

ft = feet

ft² = square feet

kg = kilogram

N/A = not applicable for calculations using flow model for layer 1 to account for variable saturated thickness

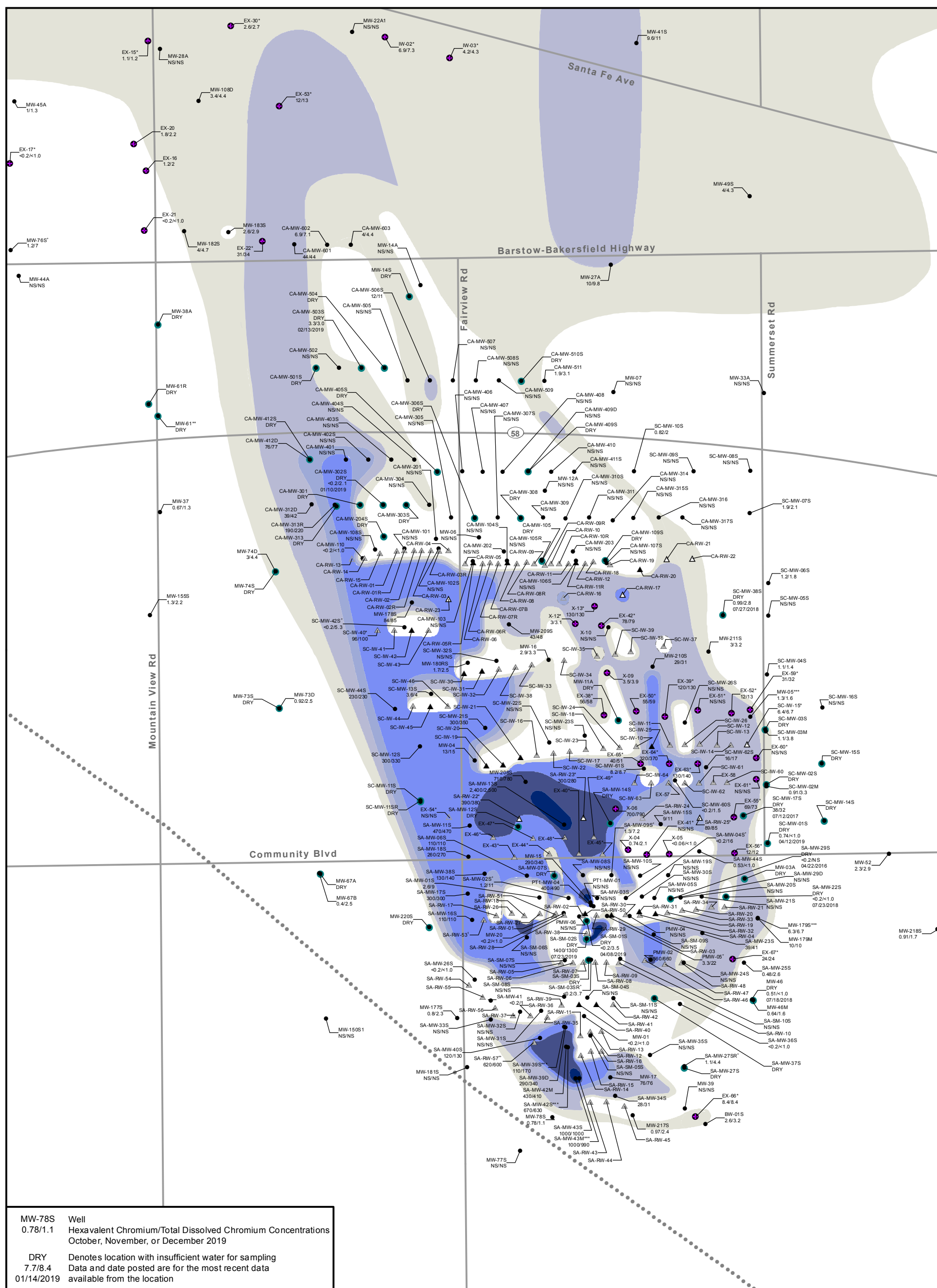
SCRIA = South Central Reinjection Area

UAU = Upper Aquifer Unit

µg/L = micrograms per liter

FIGURES





LEGEND

- Monitoring Well
- Dry Monitoring Well
- Extraction Well
- △ Active IRZ Extraction Well
- ▲ Active IRZ Injection Well
- △ Inactive IRZ Extraction Well
- ▲ Inactive IRZ Injection Well
- ● ● Approximate Location of Fault Trace is Inferred and There is No Surface Expression (Stamos et al. 2001)

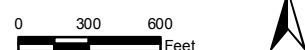
Chromium Concentrations Less than 3.1 µg/L
 Chromium Concentrations Between 3.1 and 10 µg/L
 Chromium Concentrations Between 10 and 50 µg/L
 Chromium Concentrations Between 50 and 100 µg/L
 Chromium Concentrations Between 100 and 500 µg/L
 Chromium Concentrations Between 500 and 1,000 µg/L
 Chromium Concentrations Equal to or Greater than 1,000 µg/L
 Inferred Concentration Contour

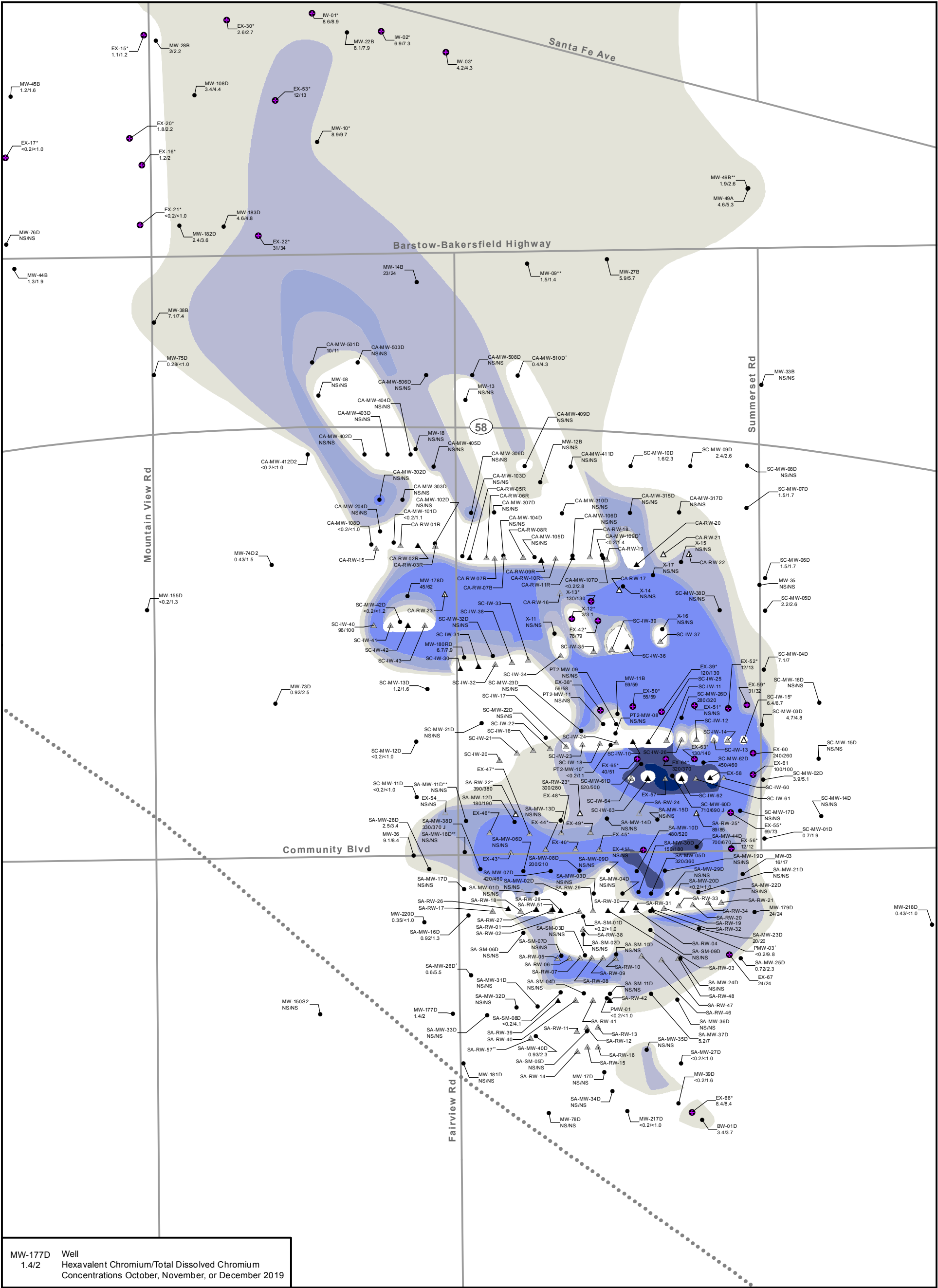
WORK CITED:
Stamos, C.L., P. Martin, T. Nishikawa, and B.F. Cox. 2001. *Simulation of Ground-Water Flow in the Mojave River Basin, California*. U.S. Geological Survey Water-Resources Investigations Report 01-4002, Version 3. Prepared in cooperation with the Mojave Water Agency.

NOTES:
 µg/L = Micrograms per Liter
 IRZ= In Situ Reactive Zone
 NS = Not Sampled
 < = Below Reporting Limit (as shown)
 *Remedial wells screened across both shallow and deep zones of the upper aquifer; Data not used in contouring
 **Well destroyed by Highway 58 construction
 *** Data not used in contouring
 † Total dissolved chromium concentration data not used in contouring
 †† Location is approximated; survey pending
 † Well dry upon installation and not connected to the injection system

FIGURE B-1
IRZ AREA TOTAL DISSOLVED CHROMIUM AND
HEXAVALENT CHROMIUM CONCENTRATIONS
(SHALLOW ZONE OF THE UPPER AQUIFER)
FOURTH QUARTER 2019

FOUR YEAR COMPREHENSIVE CLEANUP STATUS AND
EFFECTIVENESS REPORT (2016 to 2019)
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA





- LEGEND**
- Monitoring Well
 - ⊕ Extraction Well
 - △ Active IRZ Extraction Well
 - ▲ Active IRZ Injection Well
 - △ Inactive IRZ Extraction Well
 - ▲ Inactive IRZ Injection Well

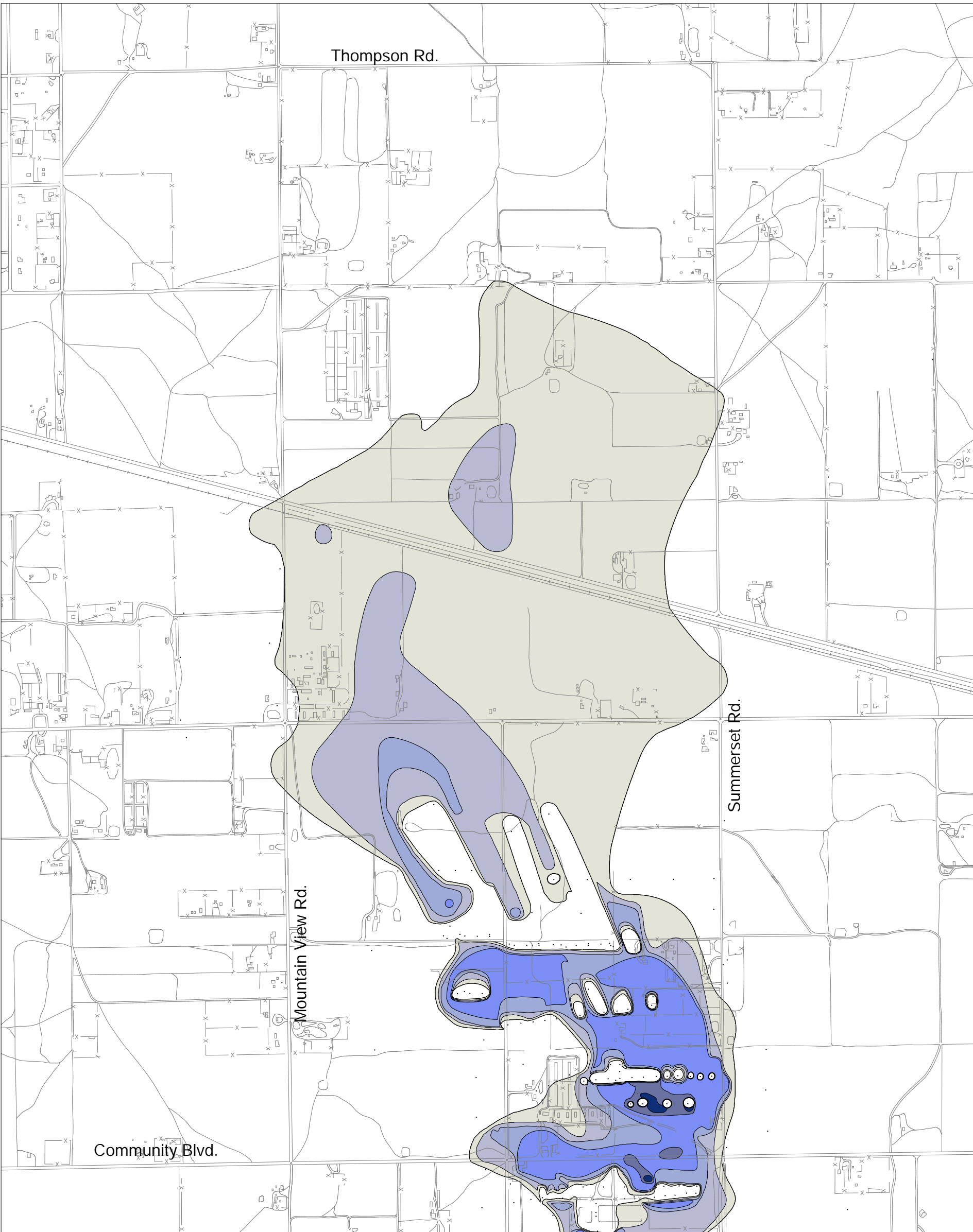
- Chromium Concentrations Less than 3.1 µg/L
 - Chromium Concentrations Between 3.1 and 10 µg/L
 - Chromium Concentrations Between 10 and 50 µg/L
 - Chromium Concentrations Between 50 and 100 µg/L
 - Chromium Concentrations Between 100 and 500 µg/L
 - Chromium Concentrations Between 500 and 1,000 µg/L
 - Chromium Concentrations Equal to or Greater than 1,000 µg/L
 - - - Inferred Concentration Contour
 - Approximate Location of Fault Trace is Inferred and There is No Surface Expression (Stamos et al. 2001)
- WORK CITED:**
Stamos, C.L., P. Martin, T. Nishikawa, and B.F. Cox. 2001.
Simulation of Ground-Water Flow in the Mojave River Basin, California. U.S. Geological Survey Water-Resources Investigations Report 01-4002, Version 3. Prepared in cooperation with the Mojave Water Agency.

NOTES:
µg/L = Micrograms per Liter
IRZ = In Situ Reactive Zone
J = Estimated Result
NS = Not Sampled
< = Below Reporting Limit (as shown)
*Remedial wells screened across both shallow and deep zones of the upper aquifer; Data not used in contouring
**Data not used in contouring
*Total dissolved chromium concentration data not used in contouring
**Location is approximated; survey pending

**FIGURE 3-3
IRZ AREA TOTAL DISSOLVED CHROMIUM AND
HEXAVALENT CHROMIUM CONCENTRATIONS
(DEEP ZONE OF THE UPPER AQUIFER)
FOURTH QUARTER 2019**

FOUR YEAR COMPREHENSIVE CLEANUP STATUS AND
EFFECTIVENESS REPORT (2016 to 2019)
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA





The contours were prepared by combining the plumes south of Highway 58 for the deep zone of the upper aquifer south of Highway 58 (Figure B-1) with the plume contours for the deep zone of the upper aquifer north of Highway 58 from the Fourth Quarter 2019 Groundwater Monitoring Program (GMP) report (Figure 5-2, from the GMP report included in Appendix A, Arcadis 2020).

Arcadis 2020. Fourth Quarter of 2019 Groundwater Monitoring Report and Domestic Well Sampling Results. Site-wide Groundwater Monitoring Program. Hinkley Compressor Station, Hinkley, California. February.

- Legend**
- Chromium Concentrations Less Than 3.1 µg/L
 - Chromium Concentrations Between 3.1 and 10 µg/L
 - Chromium Concentrations Between 10 and 50 µg/L
 - Chromium Concentrations Between 50 and 100 µg/L
 - Chromium Concentrations Between 100 and 500 µg/L
 - Chromium Concentrations Between 500 and 1,000 µg/L
 - Chromium Concentrations Greater Than 1,000 µg/L

Notes:
µg/L = Micrograms per liter

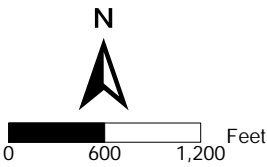
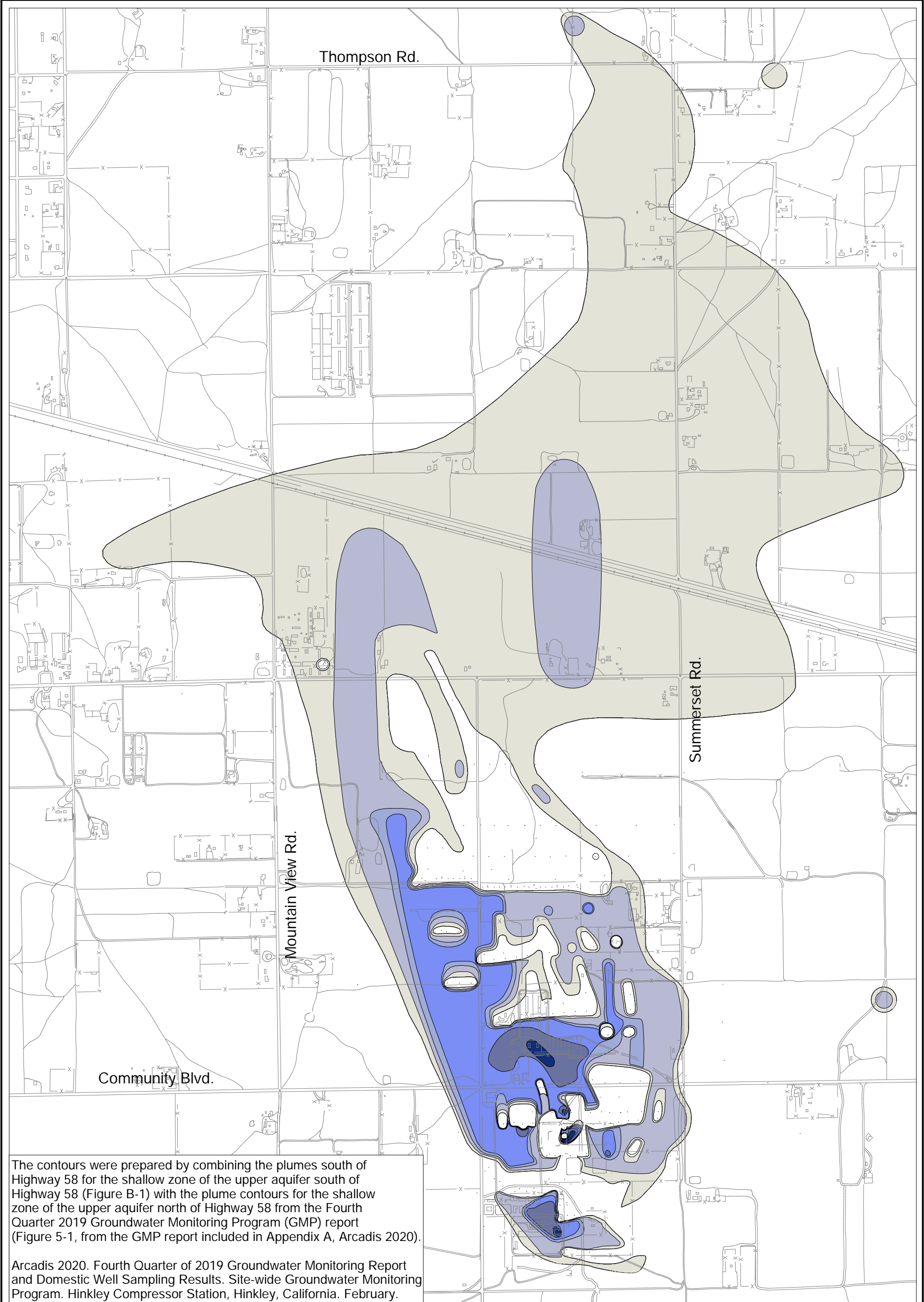


FIGURE B-4
FOURTH QUARTER 2019 HEXAVALENT CHROMIUM
ISOCONCENTRATION CONTOURS, IN THE DEEP
ZONE OF THE UPPER AQUIFER, SOUTHERN
CHROMIUM PLUME

FOUR-YEAR COMPREHENSIVE CLEANUP STATUS AND
EFFECTIVENESS REPORT (2016 TO 2019)
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY, CALIFORNIA





The contours were prepared by combining the plumes south of Highway 58 for the shallow zone of the upper aquifer south of Highway 58 (Figure B-1) with the plume contours for the shallow zone of the upper aquifer north of Highway 58 from the Fourth Quarter 2019 Groundwater Monitoring Program (GMP) report (Figure 5-1, from the GMP report included in Appendix A, Arcadis 2020).

Arcadis 2020. Fourth Quarter of 2019 Groundwater Monitoring Report and Domestic Well Sampling Results. Site-wide Groundwater Monitoring Program. Hinkley Compressor Station, Hinkley, California. February.

- Legend**
- Chromium Concentrations Less Than 3.1 µg/L
 - Chromium Concentrations Between 3.1 and 10 µg/L
 - Chromium Concentrations Between 10 and 50 µg/L
 - Chromium Concentrations Between 50 and 100 µg/L
 - Chromium Concentrations Between 100 and 500 µg/L
 - Chromium Concentrations Between 500 and 1,000 µg/L
 - Chromium Concentrations Greater Than 1,000 µg/L

Notes:
µg/L = Micrograms per liter

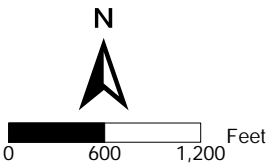


FIGURE B-3
FOURTH QUARTER 2019 HEXAVALENT CHROMIUM
ISOCONCENTRATION CONTOURS, IN THE SHALLOW
ZONE OF THE UPPER AQUIFER, SOUTHERN
CHROMIUM PLUME

FOUR-YEAR COMPREHENSIVE CLEANUP STATUS AND
EFFECTIVENESS REPORT (2016 TO 2019)
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY, CALIFORNIA



APPENDIX C

Monitoring Frequency



Appendix C

2019 Annual Sampling Frequency Evaluation under Clean-up and Abatement Order R6V-2015-0068, Pacific Gas and Electric Company Hinkley Compressor Station, Hinkley, California

The Clean-up and Abatement Order (CAO) for chromium in groundwater at the Pacific Gas and Electric Company (PG&E) Hinkley Compressor Station, R6V-2015-0068, specifies a dynamic monitoring program for the chromium plume in the Monitoring and Reporting Program (MRP). The MRP specifies that the sampling frequency for monitoring wells used to contour the plume boundary should be evaluated once every year in requirement I.C for the Southern Plume Area program and in requirement I.D.4 for the Northern Disputed Plumes Area program. PG&E conducted the sampling frequency evaluation using data through 2019 and identified changes in sampling frequency for 2020 according to the requirements in the CAO, as summarized in Table 1.

This appendix documents the analysis performed. PG&E will begin implementing the revised sampling frequency in the First Quarter of 2020.

Quarterly Branches

Requirements 1.D.4.a for the north and I.C.2 of the sampling evaluation framework for the south specify the method for evaluation of quarterly monitoring wells, as shown on the quarterly branches of Figures 8-1 and 8-2 of the MRP. In accordance with 1.C.2 and 1.D.4.a, if the hexavalent chromium (Cr[VI]) concentration is less than 3.1 parts per billion (ppb) for a period of four consecutive sampling events, the monitoring frequency will be reduced to semiannual. Semiannual wells are not sampled in the First Quarter sampling events. PG&E identified three wells that fall into this category. Data from the last four quarters of sampling for these wells are provided in Table 2 to demonstrate satisfaction of this criterion. The three wells are also shown on Table 1, with “Quarterly” as the “2019 Groundwater Monitoring Program (GMP) Sampling Frequency” and “Decrease to semiannual sampling” in the “Review of Initial Data Path Forward” and “Semiannually” in the “2020 GMP Sampling Frequency” column. The three wells identified in this category, including PGE-06. PGE-06 could decrease to semiannual sampling, however, based on nearby data, it is planned to continue quarterly sampling to monitor the southeast plume.

Additionally, under the same requirements (1.D.4.a and I.C.2) and per the quarterly branches on Figures 8-1 and 8-2 of the MRP, quarterly wells that do not have four consecutive sampling events with Cr(VI) concentrations less than 3.1 ppb undergo additional evaluation. If there are 12 consecutive sampling events of data in which Cr(VI) concentrations are less than 10 ppb, then the sampling frequency will be changed to semiannual if 1) the Cr(VI) is greater than 3.1 ppb and there is a decreasing Mann-Kendall statistical trend based on 12 consecutive sampling events of data, or 2) no trend based on 12 consecutive sampling events of data. PG&E identified 16 wells that fall into this category. The 16 wells are those with a “2019 GMP Sampling Frequency” of “Quarterly” in Table 1 and with a note “Perform MK Analysis” in the “Review of Initial Data Path Forward,” meaning that the 12 consecutive sampling events did not yield concentrations above 10 ppb. Data from the last 12 quarters of sampling was used for the

Mann-Kendall analysis. The data analyzed and the Mann-Kendall analysis results are provided in the attached Tables 3 and 4, respectively. Of the 16 wells analyzed by Mann-Kendall, ten show a decreasing or no statistical trend. These wells are listed as “Semiannually” in the “2020 GMP Sampling Frequency” column of Table 1. The ten wells identified include MW-80S, which is planned to continue quarterly monitoring to verify 10 ppb plume delineation in the north. PG&E does not plan to sample the other 9 wells in the First Quarter of 2020, unless sampling is needed under a different program (i.e. a well is required quarterly in the ATU program as indicated in Table 1).

Semiannual Branches

Under requirement 1.D.4.b for the north and the semiannual branch of Figure 8-2 of the MRP, the sampling evaluation framework specifies that for a semiannual well, if the Cr(VI) concentration is less than 3.1 ppb for four consecutive events, then the frequency will be decreased to annually. However, in the north, if all wells in a cluster may be decreased to annually, the well with the maximum concentration will remain at semiannual sampling. Therefore, at least one well in each cluster will be sampled semiannually. PG&E identified 14 wells that fall into this category. The Cr(VI) data from last four quarters of sampling for these wells are provided in Table 5. However, only four of these wells have another well in the cluster sampled quarterly or semiannually and do not have the highest Cr(VI) concentration within the cluster. On Table 1, these four wells are indicated as “Semiannually” for “2019 GMP Sampling Frequency,” “Decrease to annual sampling” in the “Review of Initial Data Path Forward” column, and “Annually” in the “2020 GMP Sampling Frequency” column. The other ten wells were retained at semi-annual sampling to ensure that at least one well within northern multi-well clusters is retained for semi-annual sampling.

Furthermore, under requirement 1.D.4.b for the north, for semiannual wells that do not have four consecutive sampling events with Cr(VI) concentrations less than 3.1 ppb, a Mann-Kendall analysis was performed. The sampling frequency will be changed to annual if there is a decreasing or no significant Mann-Kendall statistical trend based on 12 consecutive sampling events of data and another well in the cluster is sampled semiannually or quarterly. The 28 wells that underwent Mann-Kendall analysis under this criterion are listed in Table 1 with a “2019 GMP Sampling Frequency” of “Semiannually” and a designation of “Perform MK Analysis” in the “Review of Initial Data Path Forward” column. The Cr(VI) data from the last 12 quarters of sampling and the Mann-Kendall analysis results are provided in the attached Tables 3 and 4, respectively. The sampling frequency will remain the same (semiannually) if another well in the cluster is not being sampled semiannually or quarterly. In addition, the sampling frequency will increase to quarterly if the Mann-Kendall statistical trend shows an increasing trend based on Cr(VI) data from the last 12 quarters of sampling. Based on the Mann-Kendall analysis results, nine of these 28 wells will decrease in frequency to annually, three will increase to quarterly, as indicated in the “2020 GMP Sampling Frequency” column of Table 1. The remaining 16 wells that had decreasing or stable trends will remain at semiannual sampling because they have the highest concentration in the cluster and no other well in the cluster is sampled quarterly or semiannually.

Under requirement 1.C.2 for the south and the semiannual branch of Figure 8-1 of the MRP, the sampling evaluation framework specifies that for a semiannual well, if the Cr(VI) concentration is less than 3.1 ppb for four consecutive events, then the frequency will remain semiannual. Furthermore, for semiannual wells that do not have four consecutive sampling events with Cr(VI) concentrations less than 3.1 ppb, a Mann-Kendall analysis will be performed. The 19 wells that underwent Mann-Kendall analysis under this criterion are listed in Table 1 with a “2019 GMP Sampling Frequency” of “Semiannually” and a designation of “Perform MK Analysis” in the “Review of Initial Data Path Forward” column. The Cr(VI) data from the last 12 quarters of sampling and the Mann-Kendall analysis results are provided in the attached Tables 3 and 4, respectively. The sampling frequency will remain the same (semiannually) if the analysis indicated a decreasing or no significant Mann-Kendall statistical trend. In addition, the sampling frequency will increase to quarterly if the Mann-Kendall statistical trend shows an increasing trend based on Cr(VI) data from the last 12 quarters of sampling. Based on the Mann-Kendall analysis results, 18 of these 19 wells will remain semiannual and one will increase to quarterly, as indicated in the “2020 GMP Sampling Frequency” column of Table 1.

Annual Branch

Requirement 1.D.4.c for the north states that for an annual well, if the Cr(VI) concentration is non-detect for the last four consecutive events, then the frequency will be decreased to biennially. PG&E identified one well that falls into this category. The Cr(VI) data from the last four quarters of sampling for this well is provided in Table 6. The well is listed with “Annually” as the “2019 GMP Sampling Frequency” and “Biennially” as the “2020 GMP Sampling Frequency” in Table 1.

Finally, under requirement 1.D.4.c for annual wells in the north that do not have Cr(VI) concentrations below the non-detect value for the last four consecutive sampling events, the Mann-Kendall analysis will be performed on 12 consecutive sampling events of data. Fifty-two wells fall into this category, as indicated by “Annually” as the “2019 GMP Sampling Frequency” and “Perform MK Analysis” as the “Review of Initial Data Path Forward” in Table 1. If the Mann-Kendall analysis indicates an increasing trend, the well will be sampled semiannually. If the Mann-Kendall analysis indicates a decreasing or no significant trend, the well will continue to be sampled annually. The Cr(VI) data from the last 12 quarters of sampling and the Mann-Kendall analysis results are provided in the attached Tables 3 and 4, respectively. Based on the Mann-Kendall analysis results, four of the 52 wells will increase to semiannual sampling as indicated in the “2020 GMP Sampling Frequency” column of Table 1. An additional six wells were changed to semiannual sampling to ensure that at least one well within northern multi-well clusters is retained for semiannual sampling. These six wells have the highest concentration in the cluster while a different well in the cluster changed from semiannual to annual sampling.

The changes outlined in this appendix are consistent with the CAO. PG&E will implement these changes beginning in the First Quarter of 2020.

Attachments

Table 1	Summary of Sampling Frequency Changes for 2020
Table 2	Summary of Data from Last Four Quarters for Wells Decreasing from Quarterly to Semiannual Sampling
Table 3	Summary of Data from Last 12 Quarters for Mann-Kendall Analysis
Table 4	Summary Statistics and Mann-Kendall Test Results for Most Recent 12 Hexavalent Chromium Groundwater Monitoring Samples
Table 5	Summary of Data from Last Four Quarters for Wells Decreasing from Semiannual to Annual Sampling
Table 6	Summary of Data from Last Four Quarters for Wells Decreasing from Annual to Biennial Sampling

ATTACHMENTS



Table 1
Summary of Sampling Frequency Changes for 2020
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Program Area	2019 GMP Sampling Frequency	Review of Initial Data Path Forward ¹	Mann Kendall Trend	Basis for Change	2020 GMP Sampling Frequency ^{2, 3}	Other Programs Requiring Chromium Sampling
MW-111S1	North	Semiannually	Decrease to annual	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Annually	
MW-124D	North	Semiannually	Decrease to annual	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Annually	
MW-174S2	North	Semiannually	Decrease to annual	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Annually	
MW-200S1	North	Semiannually	Decrease to annual	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Annually	
MW-105S	North	Semiannually	Decrease to annual	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled, remains semiannual due to highest concentration of cluster	Semiannually	Sampled quarterly per R6V-2014-0023
MW-106S	North	Semiannually	Decrease to annual	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled, remains semiannual due to highest concentration of cluster	Semiannually	
MW-123S2	North	Semiannually	Decrease to annual	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled, remains semiannual due to highest concentration of cluster	Semiannually	
MW-125S1	North	Semiannually	Decrease to annual	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled, remains semiannual due to highest concentration of cluster	Semiannually	
MW-131S1	North	Semiannually	Decrease to annual	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled, remains semiannual due to highest concentration of cluster	Semiannually	
MW-156S	North	Semiannually	Decrease to annual	--	Remains semiannual due to only well in cluster	Semiannually	
MW-157S	North	Semiannually	Decrease to annual	--	Remains semiannual due to only well in cluster	Semiannually	
MW-166S1	North	Semiannually	Decrease to annual	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled, remains semiannual due to highest concentration of cluster	Semiannually	
MW-171S	North	Semiannually	Decrease to annual	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled, remains semiannual due to highest concentration of cluster	Semiannually	
MW-197S1	North	Semiannually	Decrease to annual	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled, remains semiannual due to highest concentration of cluster	Semiannually	
MW-113D	North	Annually	Decrease to Biennial	--	Cr(VI) is non-detect during last 4 quarters sampled	Biennially	
PGE-06	South	Quarterly	Decrease to Semiannual	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled, however, based on nearby data, Arcadis intends to continue quarterly monitoring to verify plume delineation	Quarterly	
MW-226D	North	Quarterly	Decrease to Semiannual	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-226S	North	Quarterly	Decrease to Semiannual	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-101D	South	Quarterly	Perform MK Analysis	UP	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK increasing trend	Quarterly	
MW-221S	South	Quarterly	Perform MK Analysis	--	Not enough data to run Mann Kendall analysis, sampling frequency does not change	Quarterly	
MW-50B	South	Quarterly	Perform MK Analysis	UP	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK increasing trend	Quarterly	
MW-80S	South	Quarterly	Perform MK Analysis	DWN	Cr(VI) < 3.1 µg/L during last 4 quarters sampled, however, based on nearby data, Arcadis intends to continue quarterly monitoring to verify plume delineation	Quarterly	
MW-121D	South	Quarterly	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	
MW-213S	South	Quarterly	Perform MK Analysis	DWN	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	
MW-66A	South	Quarterly	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	
MW-72S	South	Quarterly	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	
MW-79S	South	Quarterly	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	
C-02	South	Semiannually	Perform MK Analysis	DWN	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	Sampled semiannually per R6V-2014-0023
C-04	South	Semiannually	Perform MK Analysis	NST	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	ATU performance well, not sampled if well is not operating
EX-03	South	Semiannually	Perform MK Analysis	DWN	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	ATU performance well, not sampled if well is not operating
EX-16	South	Semiannually	Perform MK Analysis	DWN	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	
EX-23	South	Semiannually	Perform MK Analysis	NST	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	Sampled semiannually per R6V-2014-0023
EX-31	South	Semiannually	Perform MK Analysis	NST	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	Sampled quarterly per R6V-2014-0023
EX-35	South	Semiannually	Perform MK Analysis	NST	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	Sampled quarterly per R6V-2014-0023
IW-03	South	Semiannually	Perform MK Analysis	DWN	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	Sampled quarterly per R6V-2014-0023
MW-05	South	Semiannually	Perform MK Analysis	NST	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	
MW-110S	South	Semiannually	Perform MK Analysis	NST	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	

Table 1
Summary of Sampling Frequency Changes for 2020
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Program Area	2019 GMP Sampling Frequency	Review of Initial Data Path Forward ¹	Mann Kendall Trend	Basis for Change	2020 GMP Sampling Frequency ^{2, 3}	Other Programs Requiring Chromium Sampling
MW-112S	South	Semiannually	Perform MK Analysis	NST	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	
MW-153S	South	Semiannually	Perform MK Analysis	NST	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	
MW-203D	South	Semiannually	Perform MK Analysis	NST	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	
MW-49S	South	Semiannually	Perform MK Analysis	NST	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	
MW-87S	South	Semiannually	Perform MK Analysis	NST	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	
MW-95S	South	Semiannually	Perform MK Analysis	DWN	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	
MW-97S	South	Semiannually	Perform MK Analysis	NST	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	
MW-128S1	North and	Semiannually	Perform MK Analysis	UP	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK increasing trend	Quarterly	
MW-94S	North and South	Semiannually	Perform MK Analysis	NST	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	
MW-104S2	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-107D	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-113S2	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-123S1	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-125S2	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-128S2	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-128S3	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-130S2	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-133S2	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-135S2	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-137S1	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-138S2	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-139S2	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-140S2	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-140S3	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-141D	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-141S1	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-142S1	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-154S2	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-161S3	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-162S3	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-173D	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-173S2	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-174S3	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-175D	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-175S2	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-185S2	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-185S3	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-186S1	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-188S2	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-188S3	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-193S2	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-194S2	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-194S3	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-195S2	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	

Table 1
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2019 Annual Sampling Program Evaluation
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Location	Program Area	2019 GMP Sampling Frequency	Review of Initial Data Path Forward ¹	Mann Kendall Trend	Basis for Change	2020 GMP Sampling Frequency ^{2, 3}	Other Programs Requiring Chromium Sampling
MW-195S3	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-204D	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-204S1	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-205S3	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-212S2	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-219S2	North	Annually	Perform MK Analysis	--	Not enough data to run Mann Kendall analysis, sampling frequency does not change	Annually	
MW-94D	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-111S2	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend, highest concentration of cluster	Semiannually	
MW-117S2	North	Annually	Perform MK Analysis	UP	Cr(VI) > non-detect during last 4 quarters sampled, MK increasing trend	Semiannually	
MW-137S3	North	Annually	Perform MK Analysis	UP	Cr(VI) > non-detect during last 4 quarters sampled, MK increasing trend	Semiannually	
MW-142S3	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend, highest concentration of cluster	Semiannually	
MW-161S1	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend, highest concentration of cluster	Semiannually	
MW-184S1	North	Annually	Perform MK Analysis	UP	Cr(VI) > non-detect during last 4 quarters sampled, MK increasing trend	Semiannually	
MW-193S3	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend, highest concentration of cluster	Semiannually	
MW-196S1	North	Annually	Perform MK Analysis	DWN	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend, highest concentration of cluster	Semiannually	
MW-200S3	North	Annually	Perform MK Analysis	UP	Cr(VI) > non-detect during last 4 quarters sampled, MK increasing trend	Semiannually	
MW-205S2	North	Annually	Perform MK Analysis	NST	Cr(VI) > non-detect during last 4 quarters sampled, MK stable or decreasing trend, highest concentration of cluster	Semiannually	
MW-133S1	North	Quarterly	Perform MK Analysis	UP	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK increasing trend	Quarterly	
MW-207S2	North	Quarterly	Perform MK Analysis	UP	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK increasing trend	Quarterly	
MW-219S1	North	Quarterly	Perform MK Analysis	UP	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK increasing trend	Quarterly	
MW-104S1	North	Quarterly	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	
MW-154S1	North	Quarterly	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	
MW-173S1	North	Quarterly	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	
MW-174S1	North	Quarterly	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Semiannually	
MW-137S2	North	Semiannually	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-142S2	North	Semiannually	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-161S2	North	Semiannually	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-184S3	North	Semiannually	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-186S3	North	Semiannually	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-193S1	North	Semiannually	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-196S2	North	Semiannually	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-205S1	North	Semiannually	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-207S1	North	Semiannually	Perform MK Analysis	DWN	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend	Annually	
MW-117S1	North	Semiannually	Perform MK Analysis	UP	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK increasing trend	Quarterly	
MW-184S2	North	Semiannually	Perform MK Analysis	UP	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK increasing trend	Quarterly	
MW-186S2	North	Semiannually	Perform MK Analysis	UP	Cr(VI) ≥ 3.1 µg/L during last 4 quarters sampled, MK increasing trend	Quarterly	
MW-113S1	North	Semiannually	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend, remains semiannual due to highest concentration of cluster	Semiannually	
MW-130S1	North	Semiannually	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend, remains semiannual due to highest concentration of cluster	Semiannually	

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MW-135S1	North	Semiannually	Perform MK Analysis	DWN	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend, remains semiannual due to highest concentration of cluster	Semiannually	
MW-136S1	North	Semiannually	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend, remains semiannual due to highest concentration of cluster	Semiannually	
MW-138S1	North	Semiannually	Perform MK Analysis	DWN	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend, remains semiannual due to highest concentration of cluster	Semiannually	
MW-139S1	North	Semiannually	Perform MK Analysis	DWN	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend, remains semiannual due to highest concentration of cluster	Semiannually	
MW-140S1	North	Semiannually	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend, remains semiannual due to highest concentration of cluster	Semiannually	
MW-141S2	North	Semiannually	Perform MK Analysis	DWN	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend, remains semiannual due to highest concentration of cluster	Semiannually	
MW-162S1	North	Semiannually	Perform MK Analysis	DWN	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend, remains semiannual due to highest concentration of cluster	Semiannually	
MW-175S1	North	Semiannually	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend, remains semiannual due to highest concentration of cluster	Semiannually	
MW-185S1	North	Semiannually	Perform MK Analysis	DWN	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend, remains semiannual due to highest concentration of cluster	Semiannually	
MW-188S1	North	Semiannually	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend, remains semiannual due to highest concentration of cluster	Semiannually	
MW-194S1	North	Semiannually	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend, remains semiannual due to highest concentration of cluster	Semiannually	
MW-195S1	North	Semiannually	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend, remains semiannual due to highest concentration of cluster	Semiannually	
MW-204S2	North	Semiannually	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend, remains semiannual due to highest concentration of cluster	Semiannually	
MW-212S1	North	Semiannually	Perform MK Analysis	NST	Cr(VI) > 3.1 µg/L during last 4 quarters sampled, MK stable or decreasing trend, remains semiannual due to highest concentration of cluster	Semiannually	
MW-11C	South	Annually	No change to sampling frequency	--	Do not analyze to change frequency	Annually	
MW-14C	South	Annually	No change to sampling frequency	--	Do not analyze to change frequency	Annually	
MW-158CR	South	Annually	No change to sampling frequency	--	Do not analyze to change frequency	Annually	
MW-168D	South	Annually	No change to sampling frequency	--	N/A	Annually	Per MRP, GMP well downgradient of main contiguous plume sampled annually
MW-169D	South	Annually	No change to sampling frequency	--	Do not analyze to change frequency	Annually	
MW-201D	South	Annually	No change to sampling frequency	--	N/A	Annually	Per MRP, GMP well sampled annually under category of domestic well protection well
MW-59	South	Annually	No change to sampling frequency	--	Do not analyze to change frequency	Annually	
SC-MW-16C	South	Annually	No change to sampling frequency	--	Do not analyze to change frequency	Annually	
BW-01D	South	Quarterly	No change to sampling frequency	--	Cr(VI) > 10 µg/L during last 12 consecutive quarters of data	Quarterly	
BW-01S	South	Quarterly	No change to sampling frequency	--	Cr(VI) > 10 µg/L during last 12 consecutive quarters of data	Quarterly	
EX-02	South	Quarterly	No change to sampling frequency	--	Cr(VI) > 10 µg/L during last 12 consecutive quarters of data	Quarterly	Sampled quarterly per R6V-2014-0023
IW-01	South	Quarterly	No change to sampling frequency	--	Cr(VI) > 10 µg/L during last 12 consecutive quarters of data	Quarterly	
IW-02	South	Quarterly	No change to sampling frequency	--	Cr(VI) > 10 µg/L during last 12 consecutive quarters of data	Quarterly	
MW-03	South	Quarterly	No change to sampling frequency	--	Cr(VI) > 10 µg/L during last 12 consecutive quarters of data	Quarterly	Sampled annually per R6V-2013-0003
MW-10	South	Quarterly	No change to sampling frequency	--	Cr(VI) > 10 µg/L during last 12 consecutive quarters of data	Quarterly	
MW-100C	South	Quarterly	No change to sampling frequency	--	Cr(VI) > 10 µg/L during last 12 consecutive quarters of data	Quarterly	
MW-108D	South	Quarterly	No change to sampling frequency	--	Cr(VI) > 10 µg/L during last 12 consecutive quarters of data	Quarterly	

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MW-108S	South	Quarterly	No change to sampling frequency	--	Cr(VI) > 10 µg/L during last 12 consecutive quarters of data	Quarterly	
MW-109	South	Quarterly	No change to sampling frequency	--	Cr(VI) > 10 µg/L during last 12 consecutive quarters of data	Quarterly	
MW-118S	South	Quarterly	No change to sampling frequency	--	N/A	Quarterly	Per MRP, sampled quarterly in GMP as a domestic well protection well
MW-220S	South	Quarterly	No change to sampling frequency	--	Not enough data for analysis, sampling frequency does not change	Quarterly	
MW-23B	South	Quarterly	No change to sampling frequency	--	Cr(VI) > 10 µg/L during last 12 consecutive quarters of data	Quarterly	
MW-30B2	South	Quarterly	No change to sampling frequency	--	Cr(VI) > 10 µg/L during last 12 consecutive quarters of data	Quarterly	
MW-41S	South	Quarterly	No change to sampling frequency	--	Cr(VI) > 10 µg/L during last 12 consecutive quarters of data	Quarterly	
MW-50S	South	Quarterly	No change to sampling frequency	--	Cr(VI) > 10 µg/L during last 12 consecutive quarters of data	Quarterly	
MW-92C	South	Quarterly	No change to sampling frequency	--	Cr(VI) > 10 µg/L during last 12 consecutive quarters of data	Quarterly	
C-01	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	ATU performance well, not sampled if well is not operating
DW-03	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
EX-04	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	ATU performance well, not sampled if well is not operating
EX-05	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
EX-15	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
EX-17	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
EX-20	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
EX-21	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
EX-32	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	Sampled semiannually per R6V-2014-0023
EX-33	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	Sampled quarterly per R6V-2014-0023
EX-36	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
G-1R	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	ATU performance well, not sampled if well is not operating
G-2R	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	Sampled quarterly per R6V-2014-0023
MW-09	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-102D	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-116D1	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-121S	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-122D	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-124S2	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-126S1	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-126S2	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-147D	South	Semiannually	No change to sampling frequency	--	N/A	Semiannually	Per MRP, GMP well downgradient of main contiguous plume sampled semiannually
MW-147S	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-148S	South	Semiannually	No change to sampling frequency	--	N/A	Semiannually	Per MRP, GMP well downgradient of main contiguous plume sampled semiannually
MW-164D	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-164S	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-168S	South	Semiannually	No change to sampling frequency	--	N/A	Semiannually	Per MRP, GMP well downgradient of main contiguous plume sampled semiannually
MW-169S2	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-172S2	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-201S	South	Semiannually	No change to sampling frequency	--	N/A	Semiannually	Per MRP, GMP well sampled semiannually under category of domestic well protection well
MW-202S	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-213D	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	

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Location	Program Area	2019 GMP Sampling Frequency	Review of Initial Data Path Forward ¹	Mann Kendall Trend	Basis for Change	2020 GMP Sampling Frequency ^{2, 3}	Other Programs Requiring Chromium Sampling
MW-214D	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-214S	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-215D	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-215S	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-216D	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-216S	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-217D	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	Sampled quarterly for IRZ
MW-217S	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	Sampled quarterly for IRZ
MW-218D	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-218S	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-21C	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-220D	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-23C	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-28C	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-31C	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-34	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-37	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	Sampled quarterly per April 20, 2016 NOA
MW-42C	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-43	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-44A	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-44B	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-45A	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-45B	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-47	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-54	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-55C	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-57	South	Semiannually	No change to sampling frequency	--	N/A	Semiannually	Per MRP, GMP well downgradient of main contiguous plume sampled semiannually
MW-57D	South	Semiannually	No change to sampling frequency	--	N/A	Semiannually	Per MRP, GMP well downgradient of main contiguous plume sampled semiannually
MW-58	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-62A	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-62C	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-68C	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-69D	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-69S	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-76S	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-87D	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-90C	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-91C	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-93C	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-96S	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-98C	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-99C	South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-107S	North and South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	

Table 1
Summary of Sampling Frequency Changes for 2020
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Program Area	2019 GMP Sampling Frequency	Review of Initial Data Path Forward ¹	Mann Kendall Trend	Basis for Change	2020 GMP Sampling Frequency ^{2, 3}	Other Programs Requiring Chromium Sampling
MW-124S1	North and South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-172S1	North and South	Semiannually	No change to sampling frequency	--	Cr(VI) < 3.1 µg/L during last 4 quarters sampled	Semiannually	
MW-104D	North	Biennially	No change to sampling frequency	--	Do not analyze to change frequency	Biennially	
MW-105D	North	Biennially	No change to sampling frequency	--	Do not analyze to change frequency	Biennially	Sampled quarterly per R6V-2014-0023
MW-106D	North	Biennially	No change to sampling frequency	--	Do not analyze to change frequency	Biennially	
MW-111D	North	Biennially	No change to sampling frequency	--	Do not analyze to change frequency	Biennially	
MW-117D	North	Biennially	No change to sampling frequency	--	Do not analyze to change frequency	Biennially	
MW-136S2	North	Biennially	No change to sampling frequency	--	Do not analyze to change frequency	Biennially	
MW-162S2	North	Biennially	No change to sampling frequency	--	Do not analyze to change frequency	Biennially	
MW-166S2	North	Biennially	No change to sampling frequency	--	Do not analyze to change frequency	Biennially	
MW-171D1	North	Biennially	No change to sampling frequency	--	Do not analyze to change frequency	Biennially	
MW-171D2	North	Biennially	No change to sampling frequency	--	Do not analyze to change frequency	Biennially	
MW-196S3	North	Biennially	No change to sampling frequency	--	Do not analyze to change frequency	Biennially	
MW-197S2	North	Biennially	No change to sampling frequency	--	Do not analyze to change frequency	Biennially	
MW-197S3	North	Biennially	No change to sampling frequency	--	Do not analyze to change frequency	Biennially	
MW-200S2	North	Biennially	No change to sampling frequency	--	Do not analyze to change frequency	Biennially	

Notes:

¹ Per the 2015 CAO, the first step to determine changes to the sampling frequency are based on the most recent 4 or 12 events (depending on location and current sampling frequency). This column indicates the required next step based on initial data review.

² After the MK trend analysis was performed, the final recommendation for 2019 sampling frequency was determined. If no MK trend analysis was required, the 2019 sampling frequency is the same as the initial path forward.

³ Wells that are in other reporting programs will not be reduced in sampling frequency unless the other program ends. For example, wells in the ATU program will continue to be monitored quarterly, even if they are recommended to be reduced in the GMP program.

Wells that show "North and South" in the "Program Area" column are located north of Thompson Road (northern area) but also outlined in the MRP Attachment A: Southern Plume Area Monitoring Program

Abbreviations:

- < = less than
- ATU = Agricultural Treatment Units
- CAO = Cleanup and Abatement Order R6V-2015-0068
- Cr(VI) = hexavalent chromium
- DWN = decreasing trend per MK analysis
- GMP = Groundwater Monitoring Program
- IRZ = In-situ Reactive Zone
- MK = Mann Kendall trend analysis
- MRP = Monitoring and Reporting Program
- N/A = not applicable
- NST = no significant trend per MK analysis
- UP = increasing trend per MK analysis
- µg/L = micrograms per liter

Table 2**Summary of Data from Last Four Quarters****Sampled for Wells Decreasing from Quarterly to Semiannual Sampling****2019 Annual Sampling Program Evaluation****Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California****Design & Consultancy
for natural and
built assets**

Location	Date	Cr(VI) Concentration µg/L
MW-226D	1/15/2019	0.47
MW-226D	4/3/2019	< 0.2
MW-226D	7/9/2019	< 0.2
MW-226D	10/14/2019	< 0.2
MW-226S	1/15/2019	2.2
MW-226S	4/3/2019	2.7
MW-226S	7/9/2019	2.8
MW-226S	10/14/2019	2.5
MW-226S	12/5/2019	2.8
PGE-06	10/18/2018	0.74
PGE-06	2/12/2019	0.70
PGE-06	4/11/2019	0.81
PGE-06	7/26/2019	0.94

Abbreviations:

Cr(VI)= hexavalent chromium

µg/L = micrograms per liter

< = less than reporting limit listed

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis



Design & Consultancy
for natural and
built assets

2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) μg/L
C-02	1/5/2016	6.3
C-02	4/5/2016	5.6
C-02	7/21/2016	1.4
C-02	10/4/2016	5.1
C-02	12/8/2016	5.9
C-02	1/5/2017	5.8
C-02	4/6/2017	5.6
C-02	7/20/2017	5.2
C-02	10/3/2017	5.4
C-02	4/5/2018	4.9
C-02	10/5/2018	4.2
C-02	4/4/2019	3.6
C-02	10/10/2019	3.2
C-04	10/23/2015	2.9
C-04	1/12/2016	2.4
C-04	4/5/2016	2.6
C-04	7/21/2016	2.6
C-04	10/4/2016	2.3
C-04	1/5/2017	2.3
C-04	4/6/2017	2.2
C-04	10/3/2017	3.1
C-04	4/5/2018	3.2
C-04	10/16/2018	< 0.2
C-04	4/4/2019	< 0.2
C-04	10/22/2019	2.5
EX-03	7/10/2015	5.1
EX-03	11/3/2015	3.2
EX-03	1/14/2016	3.2
EX-03	4/14/2016	3.1
EX-03	7/21/2016	< 0.06
EX-03	10/13/2016	0.35
EX-03	4/20/2017	2.9
EX-03	10/3/2017	5.7
EX-03	4/5/2018	4.1
EX-03	10/16/2018	2.6
EX-03	11/28/2018	3.1
EX-03	4/4/2019	< 0.2
EX-03	10/17/2019	1.7
EX-03	12/5/2019	0.45
EX-16	7/10/2015	5.6
EX-16	10/13/2015	4.9
EX-16	1/12/2016	4.4
EX-16	4/7/2016	3.8
EX-16	7/12/2016	4.1
EX-16	10/6/2016	3.8

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis



Design & Consultancy
for natural and
built assets

2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) μg/L
EX-16	4/18/2017	3.5
EX-16	10/5/2017	3.2
EX-16	4/5/2018	3.0
EX-16	10/16/2018	1.8
EX-16	4/11/2019	7.7
EX-16	6/7/2019	4.1
EX-16	10/18/2019	1.2
EX-23	1/14/2016	2.1
EX-23	4/7/2016	2.2
EX-23	7/12/2016	2.8
EX-23	10/13/2016	2.1
EX-23	1/11/2017	1.8
EX-23	4/13/2017	2.3
EX-23	7/13/2017	2.2
EX-23	10/5/2017	2.1
EX-23	4/5/2018	2.2
EX-23	10/17/2018	2.0
EX-23	4/9/2019	2.1
EX-23	10/15/2019	1.7
EX-23	12/5/2019	5.9
EX-31	1/5/2017	5.5
EX-31	4/18/2017	4.5
EX-31	7/18/2017	6.2
EX-31	10/3/2017	6.2
EX-31	1/10/2018	5.6
EX-31	4/5/2018	5.6
EX-31	7/17/2018	3.5
EX-31	9/6/2018	2.9
EX-31	10/5/2018	4.6
EX-31	2/12/2019	3.4
EX-31	3/7/2019	5.2
EX-31	4/11/2019	3.9
EX-31	6/7/2019	3.3
EX-31	7/11/2019	4.1
EX-31	9/5/2019	4.6
EX-31	10/17/2019	3.8
EX-31	12/5/2019	5.4
EX-35	10/6/2015	3.8
EX-35	1/5/2016	2.7
EX-35	4/7/2016	2.1
EX-35	7/21/2016	3.4
EX-35	10/4/2016	2.1
EX-35	1/6/2017	2.0 J
EX-35	4/18/2017	1.8
EX-35	10/4/2017	4.1

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California



Design & Consultancy
for natural and
built assets

Location	Date	Cr(VI) μg/L
EX-35	4/5/2018	3.7
EX-35	10/5/2018	3.7
EX-35	4/9/2019	1.8
EX-35	10/17/2019	1.5
IW-03	10/13/2015	5.0
IW-03	1/12/2016	5.2
IW-03	4/5/2016	5.1
IW-03	7/19/2016	4.8
IW-03	10/11/2016	5.4
IW-03	1/11/2017	5.4
IW-03	4/13/2017	5.0
IW-03	10/5/2017	5.0
IW-03	4/3/2018	4.6
IW-03	10/16/2018	4.3
IW-03	4/4/2019	0.16
IW-03	10/10/2019	4.2
MW-05	7/15/2015	0.64
MW-05	10/21/2015	< 0.75
MW-05	1/21/2016	0.65
MW-05	4/13/2016	0.65
MW-05	7/18/2016	0.63
MW-05	11/1/2016	0.62
MW-05	4/18/2017	0.59
MW-05	10/12/2017	0.57
MW-05	4/17/2018	4.7
MW-05	10/2/2018	0.83
MW-05	4/10/2019	2.7
MW-05	10/21/2019	1.3
MW-101D	1/12/2016	2.6
MW-101D	4/21/2016	3.3
MW-101D	6/2/2016	3.9
MW-101D	7/14/2016	3.6
MW-101D	10/20/2016	3.6
MW-101D	4/13/2017	3.3
MW-101D	10/12/2017	3.7
MW-101D	4/12/2018	4.4
MW-101D	10/16/2018	5.9
MW-101D	11/29/2018	6.8
MW-101D	2/11/2019	5.9
MW-101D	4/9/2019	5.8
MW-101D	7/10/2019	5.7
MW-101D	9/3/2019	5.2
MW-101D	10/18/2019	5.8
MW-104S1	10/12/2016	3.2

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis



Design & Consultancy
for natural and
built assets

2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) μg/L
MW-104S1	2/2/2017	3.3
MW-104S1	4/5/2017	3.1
MW-104S1	7/12/2017	3.5
MW-104S1	10/5/2017	3.3
MW-104S1	1/9/2018	3.4
MW-104S1	4/5/2018	3.5
MW-104S1	10/10/2018	3.4
MW-104S1	2/11/2019	3.2
MW-104S1	4/3/2019	3.2
MW-104S1	7/9/2019	3.7
MW-104S1	10/22/2019	3.3
MW-104S2	4/17/2014	2.6
MW-104S2	7/24/2014	3.1
MW-104S2	10/8/2014	3.3
MW-104S2	1/12/2015	3.2
MW-104S2	4/6/2015	3.1
MW-104S2	7/9/2015	3.2
MW-104S2	10/8/2015	3.0
MW-104S2	4/6/2016	3.1
MW-104S2	10/12/2016	2.9
MW-104S2	10/5/2017	2.8
MW-104S2	10/10/2018	2.9
MW-104S2	10/22/2019	2.8
MW-107D	4/16/2014	0.86
MW-107D	7/22/2014	0.56
MW-107D	10/9/2014	1.0
MW-107D	1/19/2015	1.9 J
MW-107D	4/6/2015	0.80
MW-107D	7/8/2015	< 0.06
MW-107D	10/15/2015	1.6
MW-107D	4/7/2016	0.87
MW-107D	10/4/2016	0.24
MW-107D	10/9/2017	< 0.2
MW-107D	11/30/2017	< 0.2
MW-107D	10/1/2018	< 0.2
MW-107D	10/11/2019	< 0.2
MW-110S	4/15/2016	4.4
MW-110S	7/13/2016	4.1
MW-110S	10/18/2016	4.0
MW-110S	2/2/2017	4.2
MW-110S	4/12/2017	3.8
MW-110S	6/7/2017	4.5
MW-110S	7/20/2017	4.6
MW-110S	10/11/2017	3.8
MW-110S	1/11/2018	4.3

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis



Design & Consultancy
for natural and
built assets

2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) μg/L
MW-110S	3/5/2018	3.7
MW-110S	4/18/2018	4.0
MW-110S	10/19/2018	4.9
MW-110S	4/8/2019	4.9
MW-110S	10/21/2019	1.9
MW-110S	12/4/2019	5.0
MW-111S2	7/22/2014	2.1
MW-111S2	10/8/2014	2.6
MW-111S2	1/15/2015	2.6
MW-111S2	4/6/2015	2.6
MW-111S2	7/9/2015	2.6
MW-111S2	10/9/2015	2.4
MW-111S2	4/6/2016	2.4
MW-111S2	10/11/2016	2.3
MW-111S2	10/18/2017	2.5
MW-111S2	4/6/2018	2.4
MW-111S2	10/10/2018	1.9
MW-111S2	10/10/2019	2.4
MW-112S	7/9/2015	3.2
MW-112S	10/12/2015	3.2
MW-112S	1/5/2016	3.1
MW-112S	4/7/2016	3.2
MW-112S	7/13/2016	3.1
MW-112S	10/7/2016	3.2
MW-112S	4/18/2017	3.0
MW-112S	10/10/2017	2.2
MW-112S	4/9/2018	3.2
MW-112S	10/16/2018	2.8
MW-112S	4/3/2019	3.3
MW-112S	10/11/2019	3.0
MW-112S	12/3/2019	3.3
MW-113S1	10/8/2014	3.1
MW-113S1	1/12/2015	3.2
MW-113S1	4/6/2015	3.0
MW-113S1	7/9/2015	2.9
MW-113S1	10/8/2015	2.7
MW-113S1	4/6/2016	2.9
MW-113S1	10/12/2016	2.9
MW-113S1	10/18/2017	2.9
MW-113S1	4/5/2018	2.0
MW-113S1	10/19/2018	3.1
MW-113S1	4/3/2019	2.9
MW-113S1	10/9/2019	2.9
MW-113S1	12/3/2019	3.1

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California



Design & Consultancy
for natural and
built assets

Location	Date	Cr(VI) μg/L
MW-113S2	1/12/2015	3.0
MW-113S2	4/6/2015	3.0
MW-113S2	7/9/2015	2.9
MW-113S2	10/8/2015	2.8
MW-113S2	1/4/2016	3.0
MW-113S2	4/6/2016	2.9
MW-113S2	7/8/2016	2.9
MW-113S2	10/12/2016	2.7
MW-113S2	12/7/2016	2.5
MW-113S2	4/13/2017	2.9
MW-113S2	10/18/2017	2.7
MW-113S2	10/19/2018	2.9
MW-113S2	10/9/2019	2.6
MW-117S1	10/8/2014	0.53
MW-117S1	1/15/2015	0.64
MW-117S1	4/9/2015	0.61
MW-117S1	7/9/2015	0.65
MW-117S1	10/8/2015	0.77
MW-117S1	4/6/2016	0.73
MW-117S1	5/31/2016	0.81
MW-117S1	10/31/2016	0.65
MW-117S1	10/18/2017	1.3
MW-117S1	4/6/2018	1.6
MW-117S1	10/8/2018	1.4
MW-117S1	4/10/2019	0.55
MW-117S1	10/10/2019	2.8
MW-117S1	12/4/2019	3.6
MW-117S2	1/15/2015	1.1
MW-117S2	4/9/2015	1.1
MW-117S2	7/9/2015	1.2
MW-117S2	10/8/2015	1.2
MW-117S2	1/7/2016	1.3
MW-117S2	4/6/2016	1.1
MW-117S2	7/12/2016	1.3
MW-117S2	10/31/2016	1.2
MW-117S2	4/20/2017	1.2
MW-117S2	10/18/2017	1.2
MW-117S2	10/8/2018	1.2
MW-117S2	10/10/2019	1.4
MW-121D	10/13/2016	3.7
MW-121D	2/2/2017	3.6
MW-121D	4/17/2017	3.6
MW-121D	7/24/2017	3.6
MW-121D	10/12/2017	3.9
MW-121D	1/11/2018	3.9

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California



Design & Consultancy
for natural and
built assets

Location	Date	Cr(VI) μg/L
MW-121D	4/13/2018	3.8
MW-121D	10/15/2018	3.9
MW-121D	2/11/2019	3.5
MW-121D	4/9/2019	3.8
MW-121D	6/5/2019	4.0
MW-121D	7/10/2019	3.9
MW-121D	10/17/2019	3.7
MW-123S1	1/4/2016	2.0
MW-123S1	4/6/2016	2.0
MW-123S1	7/11/2016	2.0
MW-123S1	10/12/2016	1.9
MW-123S1	1/4/2017	1.9
MW-123S1	4/5/2017	2.0
MW-123S1	7/12/2017	2.0
MW-123S1	10/4/2017	1.9
MW-123S1	11/29/2017	1.9
MW-123S1	1/9/2018	1.9
MW-123S1	4/5/2018	1.9
MW-123S1	10/3/2018	1.7
MW-123S1	10/10/2019	1.6
MW-125S2	4/17/2014	1.6
MW-125S2	7/23/2014	1.6
MW-125S2	10/8/2014	1.5
MW-125S2	1/14/2015	1.6
MW-125S2	4/6/2015	1.5
MW-125S2	7/9/2015	1.6
MW-125S2	10/9/2015	1.5
MW-125S2	4/6/2016	1.5
MW-125S2	10/11/2016	1.5
MW-125S2	10/6/2017	1.6
MW-125S2	10/3/2018	1.6
MW-125S2	10/10/2019	1.5
MW-128S1	4/7/2016	2.6
MW-128S1	7/11/2016	4.0
MW-128S1	9/8/2016	8.1
MW-128S1	10/5/2016	7.7
MW-128S1	2/2/2017	3.8
MW-128S1	4/6/2017	3.4
MW-128S1	7/13/2017	6.2
MW-128S1	10/9/2017	6.4
MW-128S1	1/10/2018	6.4
MW-128S1	4/4/2018	6.5
MW-128S1	10/1/2018	5.1
MW-128S1	4/3/2019	5.8
MW-128S1	10/11/2019	9.0

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis



Design & Consultancy
for natural and
built assets

2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) μg/L
MW-128S1	12/5/2019	12
MW-128S2	10/15/2015	3.5
MW-128S2	1/7/2016	3.5
MW-128S2	4/7/2016	3.3
MW-128S2	7/11/2016	3.1
MW-128S2	10/5/2016	3.1
MW-128S2	1/3/2017	3.1
MW-128S2	4/6/2017	3.1
MW-128S2	7/13/2017	3.1
MW-128S2	10/9/2017	3.1
MW-128S2	1/10/2018	3.0
MW-128S2	10/1/2018	2.9
MW-128S2	10/11/2019	2.7
MW-128S3	10/15/2015	1.8
MW-128S3	1/7/2016	1.8
MW-128S3	4/7/2016	1.8
MW-128S3	7/11/2016	1.6
MW-128S3	10/5/2016	1.7
MW-128S3	1/3/2017	1.7
MW-128S3	4/6/2017	1.7
MW-128S3	7/13/2017	1.7
MW-128S3	10/9/2017	1.6
MW-128S3	1/10/2018	1.6
MW-128S3	10/1/2018	1.6
MW-128S3	10/11/2019	1.6
MW-130S1	7/16/2014	2.8
MW-130S1	10/7/2014	3.8
MW-130S1	1/12/2015	3.9
MW-130S1	4/2/2015	3.7
MW-130S1	7/8/2015	3.8
MW-130S1	10/12/2015	3.7
MW-130S1	4/6/2016	3.7
MW-130S1	10/11/2016	3.7
MW-130S1	10/13/2017	3.7
MW-130S1	10/9/2018	3.8
MW-130S1	4/2/2019	3.2
MW-130S1	10/8/2019	3.6
MW-130S1	12/4/2019	4.0
MW-130S2	4/1/2015	3.8
MW-130S2	7/7/2015	3.8
MW-130S2	10/12/2015	3.8
MW-130S2	1/8/2016	3.8
MW-130S2	4/6/2016	3.6
MW-130S2	7/7/2016	3.8

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California



Design & Consultancy
for natural and
built assets

Location	Date	Cr(VI) µg/L
MW-130S2	10/14/2016	3.7
MW-130S2	10/14/2016	3.8
MW-130S2	4/3/2017	3.7
MW-130S2	10/13/2017	3.8
MW-130S2	4/3/2018	3.8
MW-130S2	10/9/2018	3.7
MW-130S2	10/8/2019	3.3
MW-130S2	12/4/2019	3.9
MW-133S1	10/19/2016	7.8
MW-133S1	3/6/2017	7.3
MW-133S1	4/20/2017	7.5
MW-133S1	7/26/2017	7.6
MW-133S1	10/16/2017	8.3
MW-133S1	1/25/2018	7.9
MW-133S1	4/17/2018	8.6
MW-133S1	10/19/2018	9.4
MW-133S1	3/4/2019	8.1
MW-133S1	4/15/2019	7.7
MW-133S1	7/23/2019	8.7
MW-133S1	10/25/2019	7.8
MW-133S2	4/7/2014	0.19
MW-133S2	7/10/2014	0.18
MW-133S2	10/7/2014	0.21
MW-133S2	1/12/2015	0.26
MW-133S2	4/2/2015	0.41
MW-133S2	7/8/2015	0.35
MW-133S2	10/7/2015	0.093
MW-133S2	4/5/2016	< 0.2
MW-133S2	10/4/2016	0.59
MW-133S2	10/2/2017	0.28
MW-133S2	10/5/2018	0.81
MW-133S2	11/29/2018	< 0.2
MW-133S2	10/8/2019	0.20
MW-135S1	4/2/2015	4.0
MW-135S1	7/8/2015	4.0
MW-135S1	10/7/2015	4.0
MW-135S1	1/4/2016	3.8
MW-135S1	3/1/2016	3.6
MW-135S1	4/5/2016	3.8
MW-135S1	7/7/2016	3.8
MW-135S1	10/14/2016	3.7
MW-135S1	4/11/2017	3.8
MW-135S1	10/31/2017	3.8
MW-135S1	10/4/2018	3.7
MW-135S1	4/8/2019	3.3

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) μg/L
MW-135S1	10/23/2019	3.5
MW-135S1	12/5/2019	4.3
MW-135S2	4/2/2015	2.5
MW-135S2	7/8/2015	3.2
MW-135S2	10/7/2015	2.7
MW-135S2	12/9/2015	2.9
MW-135S2	4/5/2016	3.1
MW-135S2	10/14/2016	2.5
MW-135S2	2/3/2017	0.99
MW-135S2	3/7/2017	2.0
MW-135S2	4/11/2017	2.7
MW-135S2	6/22/2017	3.1
MW-135S2	7/20/2017	2.9
MW-135S2	10/31/2017	1.8
MW-135S2	11/28/2017	2.6
MW-135S2	4/5/2018	2.2
MW-135S2	6/6/2018	2.1
MW-135S2	10/4/2018	1.3
MW-135S2	10/23/2019	2.7
MW-136S1	4/5/2016	3.6
MW-136S1	7/5/2016	3.5
MW-136S1	10/12/2016	3.9
MW-136S1	1/31/2017	3.9
MW-136S1	4/4/2017	3.9
MW-136S1	7/13/2017	3.9
MW-136S1	10/18/2017	3.5
MW-136S1	1/11/2018	4.0
MW-136S1	4/4/2018	3.9
MW-136S1	10/5/2018	3.7
MW-136S1	4/3/2019	3.9
MW-136S1	10/8/2019	3.6
MW-137S1	1/4/2016	4.7
MW-137S1	4/5/2016	4.6
MW-137S1	7/7/2016	4.5
MW-137S1	10/11/2016	4.7
MW-137S1	2/3/2017	4.4
MW-137S1	4/4/2017	4.8
MW-137S1	7/14/2017	4.7
MW-137S1	10/18/2017	4.3
MW-137S1	11/27/2017	4.8
MW-137S1	1/9/2018	4.2
MW-137S1	3/6/2018	4.6
MW-137S1	4/4/2018	4.5
MW-137S1	10/5/2018	4.5
MW-137S1	10/9/2019	4.3

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis



Design & Consultancy
for natural and
built assets

2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) µg/L
MW-137S2	10/7/2015	4.6
MW-137S2	4/5/2016	4.7
MW-137S2	10/11/2016	4.6
MW-137S2	2/3/2017	4.4
MW-137S2	4/4/2017	4.6
MW-137S2	7/14/2017	4.6
MW-137S2	10/18/2017	4.5
MW-137S2	11/27/2017	4.7
MW-137S2	4/4/2018	4.6
MW-137S2	7/25/2018	4.7
MW-137S2	10/5/2018	4.5
MW-137S2	4/3/2019	4.8
MW-137S2	10/9/2019	4.3
MW-137S3	10/7/2015	4.1
MW-137S3	1/4/2016	3.4
MW-137S3	4/5/2016	3.0
MW-137S3	7/7/2016	3.9
MW-137S3	10/11/2016	4.7
MW-137S3	1/4/2017	8.7
MW-137S3	4/4/2017	1.7
MW-137S3	7/14/2017	3.2
MW-137S3	10/18/2017	6.7
MW-137S3	1/9/2018	5.5
MW-137S3	3/6/2018	6.4
MW-137S3	10/5/2018	4.7
MW-137S3	10/9/2019	8.9
MW-137S3	12/4/2019	11
MW-138S1	7/8/2015	5.1
MW-138S1	10/7/2015	5.1
MW-138S1	1/5/2016	5.1
MW-138S1	4/5/2016	5.1
MW-138S1	7/7/2016	5.0
MW-138S1	10/12/2016	4.8
MW-138S1	4/4/2017	5.0
MW-138S1	10/5/2017	4.8
MW-138S1	4/4/2018	4.9
MW-138S1	10/9/2018	4.4
MW-138S1	4/3/2019	4.8
MW-138S1	10/9/2019	4.5
MW-138S2	4/17/2014	6.7
MW-138S2	7/14/2014	4.3
MW-138S2	10/7/2014	4.6
MW-138S2	1/13/2015	4.8
MW-138S2	4/3/2015	4.4

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California



Design & Consultancy
for natural and
built assets

Location	Date	Cr(VI) µg/L
MW-138S2	7/8/2015	4.6
MW-138S2	10/7/2015	4.6
MW-138S2	4/5/2016	4.5
MW-138S2	10/12/2016	4.5
MW-138S2	10/5/2017	4.4
MW-138S2	11/30/2017	4.6
MW-138S2	10/9/2018	4.4
MW-138S2	10/9/2019	4.5
MW-139S1	7/8/2015	4.7
MW-139S1	10/7/2015	4.7
MW-139S1	1/5/2016	4.6
MW-139S1	4/5/2016	4.3
MW-139S1	7/7/2016	4.3
MW-139S1	10/20/2016	4.1
MW-139S1	4/4/2017	4.0
MW-139S1	10/3/2017	4.0
MW-139S1	4/4/2018	3.7
MW-139S1	10/9/2018	3.8
MW-139S1	4/3/2019	3.6
MW-139S1	10/9/2019	3.5
MW-139S2	4/17/2014	1.8
MW-139S2	7/9/2014	1.5
MW-139S2	10/7/2014	2.2
MW-139S2	1/13/2015	1.8
MW-139S2	4/3/2015	1.2
MW-139S2	7/8/2015	1.3
MW-139S2	10/7/2015	1.2
MW-139S2	12/9/2015	1.1
MW-139S2	4/5/2016	1.2
MW-139S2	10/20/2016	1.2
MW-139S2	10/4/2017	0.51
MW-139S2	10/9/2018	1.1
MW-139S2	10/9/2019	1.2
MW-140S1	7/8/2015	4.7
MW-140S1	10/12/2015	4.8
MW-140S1	1/5/2016	4.8
MW-140S1	4/8/2016	4.5
MW-140S1	7/8/2016	4.7
MW-140S1	10/12/2016	4.7
MW-140S1	4/4/2017	4.8
MW-140S1	10/4/2017	4.2
MW-140S1	4/4/2018	4.8
MW-140S1	10/9/2018	4.6
MW-140S1	4/3/2019	4.8
MW-140S1	10/9/2019	4.6

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis

2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) µg/L
MW-140S1	12/4/2019	4.9
MW-140S2	4/18/2014	4.0
MW-140S2	7/23/2014	4.0
MW-140S2	10/8/2014	4.0
MW-140S2	1/14/2015	4.2
MW-140S2	4/3/2015	4.0
MW-140S2	7/8/2015	4.0
MW-140S2	10/12/2015	4.1
MW-140S2	4/8/2016	3.9
MW-140S2	10/12/2016	3.9
MW-140S2	10/4/2017	3.8
MW-140S2	10/9/2018	3.7
MW-140S2	10/9/2019	3.6
MW-140S3	4/18/2014	3.4
MW-140S3	7/23/2014	3.5
MW-140S3	10/8/2014	3.5
MW-140S3	1/14/2015	3.6
MW-140S3	4/3/2015	3.5
MW-140S3	7/8/2015	3.6
MW-140S3	10/12/2015	3.5
MW-140S3	10/12/2016	3.4
MW-140S3	4/4/2017	3.5
MW-140S3	10/4/2017	3.4
MW-140S3	10/9/2018	3.3
MW-140S3	10/9/2019	3.2
MW-141D	1/7/2014	0.65
MW-141D	4/18/2014	0.68
MW-141D	7/23/2014	0.07
MW-141D	10/8/2014	0.69
MW-141D	1/14/2015	0.92
MW-141D	4/3/2015	1.2
MW-141D	7/8/2015	0.34
MW-141D	10/12/2015	< 0.33
MW-141D	10/12/2016	0.21
MW-141D	10/4/2017	< 0.2
MW-141D	10/8/2018	< 0.2
MW-141D	10/9/2019	< 0.2
MW-141S1	4/18/2014	3.8
MW-141S1	7/23/2014	3.4
MW-141S1	10/8/2014	3.4
MW-141S1	1/14/2015	3.5
MW-141S1	4/3/2015	3.1
MW-141S1	7/8/2015	3.6
MW-141S1	10/12/2015	3.5

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis



Design & Consultancy
for natural and
built assets

2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) µg/L
MW-141S1	4/8/2016	2.9
MW-141S1	5/31/2016	3.6
MW-141S1	10/12/2016	3.4
MW-141S1	10/4/2017	3.2
MW-141S1	11/30/2017	3.7
MW-141S1	10/8/2018	3.4
MW-141S1	10/9/2019	3.5
MW-141S2	7/8/2015	4.1
MW-141S2	10/12/2015	4.1
MW-141S2	1/5/2016	4.2
MW-141S2	4/8/2016	3.8
MW-141S2	5/31/2016	4.1
MW-141S2	7/12/2016	4.1
MW-141S2	10/12/2016	4.0
MW-141S2	4/4/2017	4.0
MW-141S2	10/4/2017	3.9
MW-141S2	4/4/2018	4.1
MW-141S2	10/8/2018	4.0
MW-141S2	4/3/2019	4.0
MW-141S2	10/9/2019	3.9
MW-142S1	1/14/2015	5.2
MW-142S1	4/3/2015	5.1
MW-142S1	7/9/2015	5.0
MW-142S1	10/16/2015	5.7
MW-142S1	1/5/2016	5.2
MW-142S1	4/5/2016	3.8
MW-142S1	7/12/2016	4.5
MW-142S1	10/12/2016	4.4
MW-142S1	4/6/2017	4.0
MW-142S1	10/18/2017	3.5
MW-142S1	10/8/2018	2.8
MW-142S1	10/9/2019	2.7
MW-142S2	7/9/2015	3.2
MW-142S2	10/16/2015	3.0
MW-142S2	4/5/2016	3.1
MW-142S2	10/12/2016	3.0
MW-142S2	2/2/2017	2.9
MW-142S2	4/6/2017	2.8
MW-142S2	7/12/2017	3.0
MW-142S2	10/18/2017	3.1
MW-142S2	4/4/2018	3.3
MW-142S2	10/8/2018	2.9
MW-142S2	4/3/2019	3.2
MW-142S2	10/9/2019	2.6

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California



Design & Consultancy
for natural and
built assets

Location	Date	Cr(VI) µg/L
MW-142S3	1/20/2014	2.7
MW-142S3	4/18/2014	2.9
MW-142S3	7/15/2014	2.8
MW-142S3	10/8/2014	2.7
MW-142S3	1/14/2015	2.9
MW-142S3	4/3/2015	2.9
MW-142S3	7/9/2015	2.9
MW-142S3	10/16/2015	2.9
MW-142S3	10/12/2016	2.7
MW-142S3	10/18/2017	2.9
MW-142S3	10/8/2018	2.7
MW-142S3	10/9/2019	2.8
MW-153S	4/19/2016	3.7
MW-153S	7/20/2016	3.3
MW-153S	10/13/2016	3.5
MW-153S	1/31/2017	2.0
MW-153S	4/17/2017	3.7
MW-153S	7/24/2017	3.6
MW-153S	10/11/2017	3.9
MW-153S	1/23/2018	3.4
MW-153S	3/6/2018	3.6
MW-153S	4/11/2018	3.3
MW-153S	10/15/2018	3.8
MW-153S	4/8/2019	2.5
MW-153S	10/17/2019	3.0
MW-153S	12/5/2019	2.7
MW-154S1	1/18/2017	7.0
MW-154S1	4/20/2017	9.4
MW-154S1	7/26/2017	8.2
MW-154S1	10/16/2017	5.7
MW-154S1	1/25/2018	8.0
MW-154S1	4/17/2018	7.4
MW-154S1	7/25/2018	7.9
MW-154S1	10/19/2018	7.2
MW-154S1	1/16/2019	6.5
MW-154S1	4/15/2019	6.4
MW-154S1	7/23/2019	7.2
MW-154S1	10/25/2019	7.1
MW-154S2	10/7/2015	1.8
MW-154S2	1/5/2016	1.7
MW-154S2	4/5/2016	2.1
MW-154S2	7/5/2016	2.0
MW-154S2	10/4/2016	1.9
MW-154S2	1/4/2017	2.0
MW-154S2	4/6/2017	2.0

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis



Design & Consultancy
for natural and
built assets

2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) µg/L
MW-154S2	7/13/2017	2.0
MW-154S2	10/2/2017	2.2
MW-154S2	1/8/2018	2.1
MW-154S2	10/5/2018	1.5
MW-154S2	10/8/2019	2.0
MW-161S1	1/12/2015	3.5
MW-161S1	4/1/2015	3.5
MW-161S1	7/7/2015	3.4
MW-161S1	10/16/2015	3.5
MW-161S1	1/5/2016	3.4
MW-161S1	4/4/2016	3.4
MW-161S1	7/6/2016	3.4
MW-161S1	10/10/2016	3.3
MW-161S1	4/3/2017	3.4
MW-161S1	10/13/2017	3.3
MW-161S1	10/18/2018	3.4
MW-161S1	10/8/2019	3.3
MW-161S2	4/4/2016	3.3
MW-161S2	10/10/2016	3.1
MW-161S2	2/3/2017	3.0
MW-161S2	4/3/2017	3.0
MW-161S2	7/12/2017	3.3
MW-161S2	10/13/2017	3.3
MW-161S2	2/5/2018	3.4
MW-161S2	4/3/2018	2.7
MW-161S2	7/9/2018	3.1
MW-161S2	10/18/2018	3.4
MW-161S2	4/2/2019	2.9
MW-161S2	6/6/2019	3.0
MW-161S2	10/8/2019	3.1
MW-161S3	1/16/2014	1.4
MW-161S3	4/14/2014	< 1.4
MW-161S3	7/17/2014	1.5
MW-161S3	10/7/2014	1.6
MW-161S3	1/12/2015	1.0
MW-161S3	4/1/2015	1.3
MW-161S3	7/7/2015	1.3
MW-161S3	10/16/2015	1.5
MW-161S3	10/10/2016	0.84
MW-161S3	10/12/2017	0.93
MW-161S3	10/18/2018	0.94
MW-161S3	10/8/2019	0.55
MW-162S1	10/16/2015	4.2
MW-162S1	1/5/2016	4.0

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) µg/L
MW-162S1	4/4/2016	4.2
MW-162S1	7/6/2016	4.0
MW-162S1	10/10/2016	3.9
MW-162S1	1/30/2017	3.9
MW-162S1	4/3/2017	4.0
MW-162S1	10/17/2017	4.0
MW-162S1	4/3/2018	3.7
MW-162S1	6/7/2018	3.7
MW-162S1	10/12/2018	3.9
MW-162S1	4/2/2019	3.4
MW-162S1	10/8/2019	3.8
MW-162S3	1/20/2014	< 0.06
MW-162S3	4/15/2014	0.40
MW-162S3	7/18/2014	0.061
MW-162S3	10/8/2014	0.20
MW-162S3	1/13/2015	0.33
MW-162S3	4/3/2015	0.23
MW-162S3	7/8/2015	< 0.17
MW-162S3	10/22/2015	0.28
MW-162S3	10/10/2016	0.42
MW-162S3	10/17/2017	< 0.2
MW-162S3	10/12/2018	0.40
MW-162S3	10/9/2019	< 0.2
MW-173D	1/20/2014	0.58
MW-173D	4/17/2014	0.54
MW-173D	7/10/2014	0.73
MW-173D	10/8/2014	0.77
MW-173D	1/14/2015	0.87
MW-173D	4/3/2015	0.75
MW-173D	7/7/2015	0.55
MW-173D	10/8/2015	0.75
MW-173D	10/11/2016	0.61
MW-173D	10/3/2017	0.68
MW-173D	10/9/2018	0.88
MW-173D	10/10/2019	0.83
MW-173S1	2/2/2017	3.3
MW-173S1	4/11/2017	3.6
MW-173S1	7/12/2017	4.0
MW-173S1	10/3/2017	4.2
MW-173S1	1/24/2018	3.8
MW-173S1	2/5/2018	4.0
MW-173S1	3/7/2018	3.6
MW-173S1	4/4/2018	3.6
MW-173S1	7/19/2018	3.7
MW-173S1	10/9/2018	4.1

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California



Design & Consultancy
for natural and
built assets

Location	Date	Cr(VI) μg/L
MW-173S1	1/7/2019	3.5
MW-173S1	4/3/2019	4.6
MW-173S1	7/11/2019	3.6
MW-173S1	10/10/2019	3.6
MW-173S2	4/17/2014	3.0
MW-173S2	7/10/2014	2.8
MW-173S2	10/8/2014	3.0
MW-173S2	1/14/2015	2.6
MW-173S2	4/3/2015	2.9
MW-173S2	7/7/2015	2.6
MW-173S2	10/8/2015	2.9
MW-173S2	4/6/2016	3.0
MW-173S2	10/11/2016	2.9
MW-173S2	10/3/2017	3.0
MW-173S2	10/9/2018	3.1
MW-173S2	10/10/2019	3.0
MW-174S1	10/21/2016	3.3
MW-174S1	1/30/2017	3.3
MW-174S1	4/3/2017	3.3
MW-174S1	7/12/2017	3.5
MW-174S1	10/12/2017	3.4
MW-174S1	1/10/2018	3.3
MW-174S1	4/3/2018	3.4
MW-174S1	10/18/2018	3.5
MW-174S1	2/11/2019	3.1
MW-174S1	4/2/2019	3.3
MW-174S1	7/9/2019	3.5
MW-174S1	10/8/2019	3.3
MW-174S3	4/10/2014	2.6
MW-174S3	7/16/2014	2.6
MW-174S3	10/7/2014	2.7
MW-174S3	1/12/2015	2.6
MW-174S3	4/1/2015	2.7
MW-174S3	7/7/2015	2.6
MW-174S3	10/7/2015	2.6
MW-174S3	4/6/2016	2.5
MW-174S3	6/1/2016	2.7
MW-174S3	10/21/2016	2.5
MW-174S3	10/12/2017	2.6
MW-174S3	10/18/2018	2.5
MW-174S3	10/8/2019	2.4
MW-175D	4/17/2014	2.7
MW-175D	7/10/2014	2.6
MW-175D	10/8/2014	2.7

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis



Design & Consultancy
for natural and
built assets

2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) µg/L
MW-175D	1/14/2015	2.9
MW-175D	4/2/2015	2.6
MW-175D	7/7/2015	2.7
MW-175D	10/8/2015	3.2
MW-175D	10/11/2016	2.6
MW-175D	4/7/2017	2.4
MW-175D	6/22/2017	2.7
MW-175D	11/1/2017	2.7
MW-175D	10/4/2018	2.4
MW-175D	10/23/2019	2.5
MW-175S1	7/7/2015	3.2
MW-175S1	10/8/2015	3.2
MW-175S1	1/5/2016	3.3
MW-175S1	4/6/2016	3.2
MW-175S1	7/7/2016	3.2
MW-175S1	10/11/2016	3.1
MW-175S1	4/7/2017	3.1
MW-175S1	11/1/2017	3.2
MW-175S1	4/5/2018	3.3
MW-175S1	10/4/2018	3.2
MW-175S1	4/8/2019	3.3
MW-175S1	10/23/2019	3.0
MW-175S2	4/17/2014	3.2
MW-175S2	7/10/2014	3.1
MW-175S2	10/8/2014	3.2
MW-175S2	1/14/2015	3.3
MW-175S2	4/2/2015	3.2
MW-175S2	7/7/2015	3.2
MW-175S2	10/8/2015	2.7
MW-175S2	4/6/2016	3.1
MW-175S2	10/11/2016	3.0
MW-175S2	11/1/2017	3.0
MW-175S2	10/4/2018	3.1
MW-175S2	10/23/2019	3.0
MW-184S1	7/6/2015	2.0
MW-184S1	10/6/2015	1.9
MW-184S1	4/4/2016	1.9
MW-184S1	7/6/2016	1.5
MW-184S1	9/8/2016	1.7
MW-184S1	10/5/2016	1.6
MW-184S1	1/4/2017	1.8
MW-184S1	4/4/2017	2.1
MW-184S1	7/11/2017	2.2
MW-184S1	10/5/2017	2.3
MW-184S1	1/9/2018	2.7

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis



Design & Consultancy
for natural and
built assets

2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) µg/L
MW-184S1	10/11/2018	2.3
MW-184S1	10/14/2019	1.9
MW-184S2	4/10/2014	3.4
MW-184S2	7/24/2014	2.5
MW-184S2	10/6/2014	3.1
MW-184S2	1/12/2015	3.2
MW-184S2	4/1/2015	2.7
MW-184S2	7/6/2015	2.9
MW-184S2	10/6/2015	3.3
MW-184S2	10/5/2016	3.0
MW-184S2	12/7/2016	3.0
MW-184S2	10/5/2017	3.5
MW-184S2	11/29/2017	3.7
MW-184S2	10/11/2018	3.8
MW-184S2	4/2/2019	4.2
MW-184S2	10/14/2019	3.7
MW-184S3	1/4/2016	4.6
MW-184S3	4/4/2016	4.7
MW-184S3	7/6/2016	4.7
MW-184S3	10/5/2016	4.6
MW-184S3	1/30/2017	4.6
MW-184S3	4/4/2017	4.7
MW-184S3	7/11/2017	4.9
MW-184S3	10/5/2017	4.6
MW-184S3	4/3/2018	4.7
MW-184S3	10/11/2018	4.6
MW-184S3	11/28/2018	4.7
MW-184S3	4/2/2019	4.8
MW-184S3	10/14/2019	4.5
MW-185S1	7/6/2015	5.9
MW-185S1	10/6/2015	5.2
MW-185S1	1/5/2016	5.0
MW-185S1	4/4/2016	4.9
MW-185S1	7/5/2016	4.8
MW-185S1	10/5/2016	4.2
MW-185S1	4/5/2017	5.0
MW-185S1	10/5/2017	4.6
MW-185S1	4/2/2018	4.8
MW-185S1	10/17/2018	4.8
MW-185S1	4/2/2019	4.8
MW-185S1	10/7/2019	4.4
MW-185S2	4/9/2014	3.3
MW-185S2	7/17/2014	2.7
MW-185S2	10/8/2014	3.9

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) µg/L
MW-185S2	1/12/2015	3.8
MW-185S2	4/1/2015	3.8
MW-185S2	7/6/2015	3.8
MW-185S2	10/6/2015	3.4
MW-185S2	12/9/2015	4.1
MW-185S2	4/4/2016	3.9
MW-185S2	10/6/2016	3.7
MW-185S2	12/7/2016	3.7
MW-185S2	10/4/2017	3.7
MW-185S2	10/17/2018	3.6
MW-185S2	11/28/2018	3.6
MW-185S2	10/7/2019	3.7
MW-185S3	1/16/2014	3.4
MW-185S3	4/9/2014	4.2
MW-185S3	7/17/2014	4.4
MW-185S3	10/8/2014	3.8
MW-185S3	1/12/2015	4.2
MW-185S3	4/1/2015	4.0
MW-185S3	7/6/2015	4.0
MW-185S3	10/6/2015	3.9
MW-185S3	10/5/2016	3.8
MW-185S3	10/4/2017	3.9
MW-185S3	10/17/2018	3.8
MW-185S3	10/7/2019	3.8
MW-186S1	10/6/2015	4.7
MW-186S1	1/11/2016	5.2
MW-186S1	4/4/2016	5.3
MW-186S1	7/6/2016	4.8
MW-186S1	10/5/2016	4.2
MW-186S1	1/30/2017	4.6
MW-186S1	4/5/2017	4.6
MW-186S1	7/12/2017	5.0
MW-186S1	10/10/2017	4.8
MW-186S1	1/10/2018	4.6
MW-186S1	10/11/2018	4.7
MW-186S1	10/7/2019	4.6
MW-186S2	4/10/2014	3.7
MW-186S2	7/24/2014	3.1
MW-186S2	10/6/2014	2.3
MW-186S2	1/12/2015	1.6
MW-186S2	3/3/2015	1.8
MW-186S2	4/1/2015	1.4
MW-186S2	7/6/2015	1.4
MW-186S2	10/6/2015	1.9
MW-186S2	12/9/2015	3.1

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California



Design & Consultancy
for natural and
built assets

Location	Date	Cr(VI) µg/L
MW-186S2	10/5/2016	3.0
MW-186S2	12/7/2016	1.6
MW-186S2	10/9/2017	3.2
MW-186S2	11/28/2017	3.4
MW-186S2	10/10/2018	3.6
MW-186S2	11/28/2018	3.5
MW-186S2	4/2/2019	3.6
MW-186S2	6/6/2019	3.3
MW-186S2	10/7/2019	2.6
MW-186S2	12/2/2019	3.7
MW-186S3	7/5/2016	4.0
MW-186S3	10/5/2016	4.1
MW-186S3	1/4/2017	4.0
MW-186S3	4/4/2017	4.1
MW-186S3	7/11/2017	4.2
MW-186S3	10/9/2017	4.0
MW-186S3	11/28/2017	4.2
MW-186S3	1/9/2018	3.9
MW-186S3	4/2/2018	4.1
MW-186S3	6/7/2018	3.8
MW-186S3	7/9/2018	4.0
MW-186S3	10/10/2018	4.0
MW-186S3	4/2/2019	4.0
MW-186S3	6/6/2019	4.2
MW-186S3	10/7/2019	3.9
MW-186S3	12/2/2019	4.3
MW-188S1	7/7/2015	7.0
MW-188S1	10/6/2015	6.7
MW-188S1	1/11/2016	6.8
MW-188S1	4/6/2016	6.9
MW-188S1	7/7/2016	6.9
MW-188S1	10/18/2016	6.8
MW-188S1	4/4/2017	6.9
MW-188S1	10/12/2017	7.0
MW-188S1	4/2/2018	7.0
MW-188S1	10/18/2018	6.5
MW-188S1	4/2/2019	6.8
MW-188S1	10/8/2019	6.4
MW-188S2	1/22/2014	0.82
MW-188S2	4/11/2014	2.7
MW-188S2	7/17/2014	2.7
MW-188S2	10/7/2014	2.9
MW-188S2	1/14/2015	2.7
MW-188S2	4/3/2015	2.1
MW-188S2	7/7/2015	2.1

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis



Design & Consultancy
for natural and
built assets

2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) µg/L
MW-188S2	10/7/2015	3.2
MW-188S2	10/18/2016	0.86
MW-188S2	10/12/2017	1.7
MW-188S2	11/29/2017	3.0
MW-188S2	10/18/2018	3.3
MW-188S2	10/8/2019	1.7
MW-188S3	4/10/2014	4.4
MW-188S3	7/16/2014	4.3
MW-188S3	10/6/2014	4.5
MW-188S3	1/12/2015	4.7
MW-188S3	4/2/2015	4.5
MW-188S3	7/7/2015	4.6
MW-188S3	10/6/2015	4.6
MW-188S3	4/4/2016	4.2
MW-188S3	10/17/2016	4.4
MW-188S3	10/11/2017	4.5
MW-188S3	11/28/2017	4.5
MW-188S3	10/18/2018	4.5
MW-188S3	11/28/2018	4.5
MW-188S3	10/8/2019	4.2
MW-193S1	1/8/2016	4.4
MW-193S1	4/20/2016	4.5
MW-193S1	7/6/2016	4.4
MW-193S1	10/10/2016	4.3
MW-193S1	1/4/2017	4.4
MW-193S1	4/3/2017	4.5
MW-193S1	7/12/2017	4.5
MW-193S1	10/17/2017	4.5
MW-193S1	1/10/2018	4.4
MW-193S1	10/12/2018	4.5
MW-193S1	4/2/2019	4.1
MW-193S1	6/6/2019	4.4
MW-193S1	10/8/2019	3.9
MW-193S1	12/2/2019	4.6
MW-193S2	10/6/2015	11
MW-193S2	12/1/2015	4.0
MW-193S2	1/8/2016	4.2
MW-193S2	4/20/2016	3.8
MW-193S2	7/6/2016	4.0
MW-193S2	10/10/2016	6.2
MW-193S2	1/4/2017	4.7
MW-193S2	4/3/2017	4.7
MW-193S2	7/12/2017	4.0
MW-193S2	10/17/2017	4.4
MW-193S2	1/10/2018	3.2

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California



Design & Consultancy
for natural and
built assets

Location	Date	Cr(VI) µg/L
MW-193S2	10/12/2018	3.6
MW-193S2	10/8/2019	3.6
MW-193S3	1/7/2016	4.3
MW-193S3	4/21/2016	0.97
MW-193S3	7/7/2016	0.82
MW-193S3	9/8/2016	< 0.2
MW-193S3	10/11/2016	1.2
MW-193S3	12/8/2016	2.1
MW-193S3	1/5/2017	0.88
MW-193S3	4/4/2017	0.62
MW-193S3	6/7/2017	0.31
MW-193S3	7/13/2017	0.31
MW-193S3	10/17/2017	< 0.2
MW-193S3	1/11/2018	< 0.2
MW-193S3	4/3/2018	< 0.2
MW-193S3	10/16/2018	< 0.2
MW-193S3	10/8/2019	6.7
MW-194S1	10/6/2015	5.2
MW-194S1	1/6/2016	4.7
MW-194S1	4/6/2016	4.6
MW-194S1	7/6/2016	5.4
MW-194S1	10/17/2016	5.2
MW-194S1	1/31/2017	5.8
MW-194S1	4/6/2017	4.9
MW-194S1	10/11/2017	4.8
MW-194S1	4/3/2018	5.9
MW-194S1	10/10/2018	4.9
MW-194S1	4/2/2019	4.5
MW-194S1	10/14/2019	3.5
MW-194S1	12/2/2019	2.8
MW-194S2	1/16/2014	0.16
MW-194S2	3/7/2014	4.1
MW-194S2	4/9/2014	4.9
MW-194S2	7/17/2014	0.11
MW-194S2	10/6/2014	0.27
MW-194S2	1/20/2015	0.25
MW-194S2	4/2/2015	1.9
MW-194S2	7/7/2015	2.9
MW-194S2	10/6/2015	0.14
MW-194S2	10/18/2016	0.35
MW-194S2	10/11/2017	0.33
MW-194S2	10/10/2018	< 0.2
MW-194S2	11/28/2018	< 0.2
MW-194S2	10/14/2019	< 0.2

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis



Design & Consultancy
for natural and
built assets

2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) μg/L
MW-194S3	4/10/2014	0.20
MW-194S3	7/17/2014	< 0.06
MW-194S3	10/10/2014	0.97
MW-194S3	1/21/2015	1.1
MW-194S3	4/3/2015	0.68
MW-194S3	7/7/2015	< 0.14
MW-194S3	10/7/2015	0.085
MW-194S3	4/4/2016	0.34
MW-194S3	10/18/2016	0.31
MW-194S3	10/12/2017	2.1
MW-194S3	10/10/2018	0.58
MW-194S3	10/14/2019	< 0.2
MW-195S1	7/7/2015	5.1
MW-195S1	10/7/2015	5.2
MW-195S1	1/7/2016	4.3
MW-195S1	4/6/2016	3.5
MW-195S1	7/7/2016	4.5
MW-195S1	10/18/2016	4.9
MW-195S1	4/7/2017	5.0
MW-195S1	10/13/2017	5.0
MW-195S1	4/2/2018	4.9
MW-195S1	10/17/2018	5.2
MW-195S1	4/2/2019	4.8
MW-195S1	10/8/2019	4.8
MW-195S2	4/14/2014	4.2
MW-195S2	7/17/2014	4.4
MW-195S2	10/8/2014	4.4
MW-195S2	1/12/2015	4.6
MW-195S2	4/2/2015	4.4
MW-195S2	7/6/2015	4.2
MW-195S2	10/6/2015	4.4
MW-195S2	4/4/2016	4.1
MW-195S2	10/17/2016	4.0
MW-195S2	10/12/2017	4.1
MW-195S2	10/17/2018	4.0
MW-195S2	10/8/2019	3.7
MW-195S3	1/22/2014	0.75
MW-195S3	3/6/2014	3.4
MW-195S3	4/14/2014	< 1.6
MW-195S3	7/17/2014	1.5
MW-195S3	10/8/2014	1.8
MW-195S3	1/12/2015	2.2
MW-195S3	4/2/2015	1.2
MW-195S3	7/6/2015	1.8
MW-195S3	10/6/2015	2.3

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California



Design & Consultancy
for natural and
built assets

Location	Date	Cr(VI) µg/L
MW-195S3	10/17/2016	1.3
MW-195S3	10/12/2017	0.79
MW-195S3	11/29/2017	1.5
MW-195S3	10/17/2018	1.7
MW-195S3	10/8/2019	1.0
MW-195S3	12/2/2019	0.58
MW-196S1	7/16/2014	3.7
MW-196S1	10/6/2014	4.0 J
MW-196S1	11/3/2014	3.8 J
MW-196S1	12/8/2014	9.3 J
MW-196S1	12/8/2014	8.0 J
MW-196S1	12/8/2014	7.4 J
MW-196S1	12/8/2014	7.3 J
MW-196S1	1/13/2015	10 J
MW-196S1	1/13/2015	9.2 J
MW-196S1	2/3/2015	9.8 J
MW-196S1	2/4/2015	8.5 J
MW-196S1	2/5/2015	9.0 J
MW-196S1	2/6/2015	9.0 J
MW-196S1	2/9/2015	9.1 J
MW-196S1	2/10/2015	10 J
MW-196S1	2/11/2015	11 J
MW-196S1	2/12/2015	13 J
MW-196S1	2/13/2015	11 J
MW-196S1	2/13/2015	13 J
MW-196S1	2/16/2015	13 J
MW-196S1	2/17/2015	14 J
MW-196S1	2/18/2015	14 J
MW-196S1	2/19/2015	14 J
MW-196S1	2/20/2015	14 J
MW-196S1	3/2/2015	14 J
MW-196S1	3/9/2015	14 J
MW-196S1	3/10/2015	13 J
MW-196S1	3/11/2015	12 J
MW-196S1	3/12/2015	11 J
MW-196S1	3/13/2015	10 J
MW-196S1	3/16/2015	11 J
MW-196S1	3/17/2015	9.6 J
MW-196S1	3/18/2015	8.6 J
MW-196S1	3/19/2015	8.1 J
MW-196S1	3/20/2015	7.9 J
MW-196S1	3/25/2015	7.2 J
MW-196S1	3/26/2015	6.7 J
MW-196S1	3/27/2015	6.5 J
MW-196S1	3/30/2015	6.2 J
MW-196S1	3/31/2015	5.8 J
MW-196S1	4/1/2015	5.9

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis



Design & Consultancy
for natural and
built assets

2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) µg/L
MW-196S1	7/6/2015	3.8
MW-196S1	10/6/2015	3.8
MW-196S1	4/4/2016	3.7
MW-196S1	10/5/2016	3.6
MW-196S1	4/4/2017	3.6
MW-196S1	10/4/2017	3.7
MW-196S1	10/15/2018	3.7
MW-196S1	10/7/2019	3.6
MW-196S2	7/5/2016	3.2
MW-196S2	10/5/2016	3.9
MW-196S2	1/30/2017	2.4
MW-196S2	4/4/2017	2.4
MW-196S2	7/11/2017	3.1
MW-196S2	10/4/2017	4.0
MW-196S2	1/9/2018	2.6
MW-196S2	4/2/2018	2.5
MW-196S2	7/9/2018	3.7
MW-196S2	10/15/2018	3.7
MW-196S2	4/2/2019	2.4
MW-196S2	10/7/2019	3.5
MW-200S3	7/9/2014	0.37
MW-200S3	10/7/2014	0.48
MW-200S3	1/12/2015	0.37
MW-200S3	4/2/2015	0.40
MW-200S3	7/8/2015	0.47
MW-200S3	10/16/2015	0.49
MW-200S3	4/20/2016	0.47
MW-200S3	10/20/2016	0.51
MW-200S3	10/31/2017	0.60
MW-200S3	4/5/2018	0.67
MW-200S3	10/4/2018	0.68
MW-200S3	10/23/2019	0.77
MW-203D	4/21/2016	1.6
MW-203D	6/1/2016	1.6
MW-203D	7/20/2016	3.1
MW-203D	10/20/2016	0.40
MW-203D	2/1/2017	1.4
MW-203D	3/8/2017	0.24
MW-203D	4/6/2017	6.5
MW-203D	7/26/2017	2.0
MW-203D	10/17/2017	3.7
MW-203D	1/11/2018	5.1
MW-203D	4/11/2018	1.6
MW-203D	10/15/2018	0.29
MW-203D	4/8/2019	3.9

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) µg/L
MW-203D	10/17/2019	0.63
MW-203D	12/5/2019	2.4
MW-204D	4/17/2014	0.42
MW-204D	7/9/2014	0.33
MW-204D	10/7/2014	0.61
MW-204D	1/12/2015	0.67
MW-204D	4/3/2015	0.64
MW-204D	7/8/2015	0.62
MW-204D	10/16/2015	0.67
MW-204D	10/20/2016	0.46
MW-204D	11/1/2017	0.63
MW-204D	4/4/2018	0.54
MW-204D	11/27/2018	0.54
MW-204D	10/23/2019	0.44
MW-204S1	4/3/2015	3.3
MW-204S1	7/8/2015	3.4
MW-204S1	10/16/2015	3.4
MW-204S1	4/20/2016	3.4
MW-204S1	10/20/2016	3.2
MW-204S1	2/3/2017	3.1
MW-204S1	4/7/2017	3.0
MW-204S1	7/12/2017	3.3
MW-204S1	10/31/2017	3.2
MW-204S1	4/4/2018	3.3
MW-204S1	11/27/2018	3.2
MW-204S1	10/23/2019	3.1
MW-204S2	1/5/2016	4.0
MW-204S2	4/20/2016	4.2
MW-204S2	7/7/2016	4.0
MW-204S2	10/20/2016	3.8
MW-204S2	2/3/2017	4.1
MW-204S2	4/7/2017	3.6
MW-204S2	7/12/2017	3.5
MW-204S2	10/31/2017	3.8
MW-204S2	4/4/2018	3.9
MW-204S2	11/27/2018	3.7
MW-204S2	4/8/2019	3.9
MW-204S2	10/23/2019	3.7
MW-205S1	4/4/2016	2.7
MW-205S1	6/1/2016	2.6
MW-205S1	7/6/2016	3.6
MW-205S1	10/5/2016	3.8
MW-205S1	1/4/2017	3.1
MW-205S1	4/4/2017	2.8

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California



Design & Consultancy
for natural and
built assets

Location	Date	Cr(VI) µg/L
MW-205S1	7/11/2017	3.2
MW-205S1	10/2/2017	4.0
MW-205S1	1/9/2018	3.2
MW-205S1	4/2/2018	2.5
MW-205S1	10/11/2018	3.8
MW-205S1	4/2/2019	2.6
MW-205S1	10/7/2019	3.8
MW-205S2	1/12/2015	4.1
MW-205S2	4/1/2015	4.0
MW-205S2	7/6/2015	3.9
MW-205S2	10/6/2015	3.5
MW-205S2	1/6/2016	3.6
MW-205S2	3/2/2016	2.6
MW-205S2	4/4/2016	3.8
MW-205S2	6/1/2016	4.2
MW-205S2	7/6/2016	3.7
MW-205S2	10/5/2016	3.8
MW-205S2	4/4/2017	3.8
MW-205S2	10/2/2017	3.9
MW-205S2	10/11/2018	3.7
MW-205S2	10/7/2019	3.9
MW-205S3	7/6/2015	4.4
MW-205S3	10/6/2015	4.0
MW-205S3	4/4/2016	4.0
MW-205S3	7/6/2016	3.8
MW-205S3	10/5/2016	3.9
MW-205S3	1/4/2017	4.1
MW-205S3	4/4/2017	3.7
MW-205S3	7/11/2017	3.8
MW-205S3	10/2/2017	3.9
MW-205S3	1/9/2018	3.6
MW-205S3	10/11/2018	3.6
MW-205S3	10/7/2019	3.5
MW-207S1	7/8/2016	7.3
MW-207S1	10/7/2016	7.1
MW-207S1	1/11/2017	7.3
MW-207S1	4/4/2017	6.7
MW-207S1	7/14/2017	6.4
MW-207S1	10/3/2017	6.5
MW-207S1	1/11/2018	6.4
MW-207S1	4/4/2018	6.8
MW-207S1	7/25/2018	6.9
MW-207S1	10/5/2018	6.4
MW-207S1	4/8/2019	6.5
MW-207S1	10/9/2019	5.4

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis



Design & Consultancy
for natural and
built assets

2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) µg/L
MW-207S2	1/11/2017	3.1
MW-207S2	4/4/2017	3.4
MW-207S2	7/14/2017	3.6
MW-207S2	10/3/2017	3.5
MW-207S2	1/11/2018	3.5
MW-207S2	4/4/2018	3.7
MW-207S2	7/25/2018	3.7
MW-207S2	10/5/2018	3.6
MW-207S2	1/7/2019	3.5
MW-207S2	4/8/2019	3.8
MW-207S2	7/10/2019	4.1
MW-207S2	10/9/2019	3.7
MW-207S2	12/5/2019	3.9
MW-212S1	4/6/2016	3.3
MW-212S1	7/7/2016	3.4
MW-212S1	10/10/2016	3.2
MW-212S1	1/30/2017	3.1
MW-212S1	4/3/2017	3.2
MW-212S1	7/12/2017	3.4
MW-212S1	10/13/2017	3.2
MW-212S1	1/10/2018	3.2
MW-212S1	4/3/2018	3.3
MW-212S1	6/7/2018	2.7
MW-212S1	10/9/2018	3.3
MW-212S1	4/2/2019	3.2
MW-212S1	10/8/2019	3.2
MW-212S2	10/12/2015	2.8
MW-212S2	4/6/2016	2.5
MW-212S2	6/1/2016	2.5
MW-212S2	7/7/2016	3.2
MW-212S2	10/10/2016	2.9
MW-212S2	1/4/2017	2.9
MW-212S2	4/3/2017	2.6
MW-212S2	7/12/2017	3.1
MW-212S2	10/13/2017	2.3
MW-212S2	1/10/2018	1.4
MW-212S2	3/7/2018	1.7
MW-212S2	4/3/2018	1.3
MW-212S2	6/7/2018	2.0
MW-212S2	10/9/2018	2.5
MW-212S2	10/9/2019	2.1
MW-212S2	12/5/2019	2.6
MW-213S	1/12/2017	4.8
MW-213S	3/8/2017	4.4

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) µg/L
MW-213S	4/17/2017	4.8
MW-213S	7/25/2017	5.4
MW-213S	10/17/2017	5.3
MW-213S	2/5/2018	5.3
MW-213S	4/16/2018	4.9
MW-213S	7/18/2018	4.3
MW-213S	10/18/2018	4.3
MW-213S	1/15/2019	3.5
MW-213S	3/4/2019	3.9
MW-213S	4/5/2019	3.5
MW-213S	7/10/2019	3.4
MW-213S	10/15/2019	3.3
MW-219S1	3/7/2017	3.2
MW-219S1	4/18/2017	2.9
MW-219S1	7/25/2017	2.6
MW-219S1	10/18/2017	2.4
MW-219S1	11/30/2017	3.4
MW-219S1	1/17/2018	3.5
MW-219S1	4/17/2018	2.8
MW-219S1	7/18/2018	3.7
MW-219S1	10/17/2018	3.6
MW-219S1	1/15/2019	3.2
MW-219S1	4/3/2019	3.3
MW-219S1	7/9/2019	4.0
MW-219S1	10/9/2019	3.7
MW-219S2	12/8/2016	1.4
MW-219S2	3/7/2017	0.40
MW-219S2	4/18/2017	< 0.2
MW-219S2	7/25/2017	< 0.2
MW-219S2	9/5/2017	0.92
MW-219S2	10/18/2017	0.27
MW-219S2	4/16/2018	1.0
MW-219S2	10/17/2018	0.36
MW-219S2	10/9/2019	0.51
MW-221S	6/8/2018	4.4
MW-221S	7/25/2018	4.5
MW-221S	9/6/2018	5.0
MW-221S	10/1/2018	4.9
MW-221S	1/15/2019	4.2
MW-221S	4/10/2019	5.4
MW-221S	7/16/2019	5.5
MW-221S	10/11/2019	5.3
MW-49S	4/11/2016	3.9
MW-49S	7/13/2016	4.4

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California



Design & Consultancy
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built assets

Location	Date	Cr(VI) µg/L
MW-49S	10/18/2016	3.8
MW-49S	2/1/2017	5.2
MW-49S	4/13/2017	4.0
MW-49S	7/20/2017	4.1
MW-49S	10/11/2017	4.3
MW-49S	1/16/2018	4.0
MW-49S	3/7/2018	4.0
MW-49S	4/13/2018	3.8
MW-49S	10/15/2018	2.8
MW-49S	4/8/2019	3.6
MW-49S	10/24/2019	4.0
MW-50B	10/7/2016	2.8
MW-50B	4/12/2017	3.0
MW-50B	7/20/2017	3.9
MW-50B	10/19/2017	6.7
MW-50B	1/10/2018	8.2
MW-50B	4/9/2018	7.7
MW-50B	7/11/2018	7.7
MW-50B	10/9/2018	5.8
MW-50B	1/9/2019	6.3
MW-50B	4/5/2019	6.6
MW-50B	7/10/2019	7.8
MW-50B	10/24/2019	6.9
MW-66A	10/17/2016	3.6
MW-66A	2/1/2017	3.7
MW-66A	4/13/2017	3.7
MW-66A	7/19/2017	4.1
MW-66A	10/12/2017	3.9
MW-66A	1/16/2018	4.0
MW-66A	4/12/2018	4.0
MW-66A	10/16/2018	3.9
MW-66A	2/11/2019	3.5
MW-66A	4/9/2019	3.8
MW-66A	7/10/2019	3.7
MW-66A	10/25/2019	3.4
MW-72S	7/14/2016	4.8
MW-72S	10/31/2016	4.8
MW-72S	2/1/2017	4.7
MW-72S	4/11/2017	4.9
MW-72S	7/14/2017	4.8
MW-72S	1/10/2018	5.3
MW-72S	4/18/2018	5.7
MW-72S	10/10/2018	5.4
MW-72S	2/11/2019	5.4
MW-72S	4/4/2019	4.9

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis



Design & Consultancy
for natural and
built assets

2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) μg/L
MW-72S	7/9/2019	5.7
MW-72S	10/11/2019	4.5
MW-79S	1/31/2017	6.0
MW-79S	4/18/2017	6.2
MW-79S	7/14/2017	6.2
MW-79S	10/10/2017	6.5
MW-79S	1/10/2018	6.0
MW-79S	4/9/2018	6.4
MW-79S	7/20/2018	6.2
MW-79S	10/11/2018	6.3
MW-79S	1/8/2019	6.1
MW-79S	4/10/2019	6.6
MW-79S	7/9/2019	7.0
MW-79S	10/11/2019	6.0
MW-79S	12/3/2019	7.7
MW-80S	2/3/2017	7.6
MW-80S	3/8/2017	2.8
MW-80S	4/18/2017	5.2
MW-80S	6/5/2017	6.0
MW-80S	7/14/2017	3.7
MW-80S	10/10/2017	9.8
MW-80S	1/22/2018	< 0.2
MW-80S	2/5/2018	6.3
MW-80S	4/18/2018	0.34
MW-80S	7/27/2018	2.4
MW-80S	10/11/2018	1.1
MW-80S	2/12/2019	5.3
MW-80S	3/5/2019	1.8
MW-80S	4/5/2019	1.6
MW-80S	7/9/2019	0.82
MW-80S	10/11/2019	< 0.2
MW-87S	4/7/2016	2.5
MW-87S	7/13/2016	2.9
MW-87S	10/7/2016	3.3
MW-87S	1/31/2017	3.2
MW-87S	4/12/2017	3.6
MW-87S	10/10/2017	3.7
MW-87S	2/5/2018	3.4
MW-87S	4/17/2018	3.1
MW-87S	7/27/2018	2.4
MW-87S	10/11/2018	3.1
MW-87S	4/12/2019	2.3
MW-87S	10/22/2019	2.2
MW-94D	4/7/2015	2.1

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) µg/L
MW-94D	7/9/2015	4.1
MW-94D	10/8/2015	3.9
MW-94D	4/7/2016	3.3
MW-94D	10/4/2016	3.8
MW-94D	2/2/2017	3.6
MW-94D	4/18/2017	2.3
MW-94D	7/11/2017	3.1
MW-94D	10/6/2017	2.8
MW-94D	11/27/2017	3.5
MW-94D	4/4/2018	4.7
MW-94D	6/6/2018	3.9
MW-94D	10/3/2018	2.4
MW-94D	10/11/2019	3.6
MW-94S	7/9/2015	6.6
MW-94S	10/8/2015	5.9
MW-94S	1/5/2016	6.6
MW-94S	4/7/2016	6.4
MW-94S	7/11/2016	6.1
MW-94S	10/4/2016	6.1
MW-94S	4/18/2017	6.3
MW-94S	10/6/2017	6.3
MW-94S	4/4/2018	7.0
MW-94S	10/3/2018	5.6
MW-94S	4/10/2019	6.8
MW-94S	10/11/2019	6.4
MW-95S	7/16/2015	8.5
MW-95S	10/12/2015	8.6
MW-95S	1/6/2016	8.3
MW-95S	4/12/2016	8.3
MW-95S	7/19/2016	8.2
MW-95S	10/18/2016	8.2
MW-95S	4/13/2017	8.4
MW-95S	10/13/2017	8.1
MW-95S	4/16/2018	8.0
MW-95S	10/15/2018	7.9
MW-95S	4/8/2019	8.0
MW-95S	10/21/2019	6.4
MW-97S	7/13/2016	4.5
MW-97S	10/4/2016	7.0
MW-97S	1/31/2017	5.4
MW-97S	4/18/2017	6.5
MW-97S	7/14/2017	7.3
MW-97S	11/2/2017	5.6
MW-97S	11/30/2017	5.3
MW-97S	1/8/2018	6.7

Table 3
Summary of Data from Last 12 Quarters
for Mann-Kendall Analysis
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California



Design & Consultancy
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Location	Date	Cr(VI) μg/L
MW-97S	3/7/2018	5.7
MW-97S	4/9/2018	5.7
MW-97S	6/6/2018	4.8
MW-97S	7/18/2018	6.1
MW-97S	10/16/2018	5.6
MW-97S	11/27/2018	6.6
MW-97S	4/10/2019	8.2
MW-97S	6/5/2019	6.0
MW-97S	10/11/2019	6.7
MW-97S	12/3/2019	4.0

Abbreviations:

Cr(VI) = hexavalent chromium

μg/L = micrograms per liter

< = less than the reporting limit

Table 4

Summary Statistics and Mann-Kendall Test Results for the Last 12 Quarters of Hexavalent Chromium Data
 2019 Annual Sampling Program Evaluation
 Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Well ID	Analyte	Date Range	FOD	Detected Results Summary				Mann-Kendall Test		
				Range	Mean	Median	SD	Result	P-Value	S Value
C-02	Hexavalent Chromium	01/16 - 10/19	13 / 13	1.4 - 6.3	4.8	5.2	1.4	DWN	0.007	-41
C-04	Hexavalent Chromium	10/15 - 10/19	10 / 12	2.2 - 3.2	2.6	2.55	0.35	NST	0.135	-17
EX-03	Hexavalent Chromium	07/15 - 12/19	12 / 14	0.35 - 5.7	3	3.1	1.6	DWN	0.044	-32
EX-16	Hexavalent Chromium	07/15 - 10/19	13 / 13	1.2 - 7.7	3.9	3.8	1.6	DWN	0.006	-42
EX-23	Hexavalent Chromium	01/16 - 12/19	13 / 13	1.7 - 5.9	2.4	2.1	1.1	NST	0.309	-9
EX-31	Hexavalent Chromium	01/17 - 12/19	17 / 17	2.9 - 6.2	4.6	4.6	1	NST	0.069	-37
EX-35	Hexavalent Chromium	10/15 - 10/19	12 / 12	1.5 - 4.1	2.7	2.4	0.95	NST	0.084	-21
IW-03	Hexavalent Chromium	10/15 - 10/19	12 / 12	0.16 - 5.4	4.5	5	1.4	DWN	0.008	-36
MW-05	Hexavalent Chromium	07/15 - 10/19	11 / 12	0.57 - 4.7	1.3	0.65	1.3	NST	0.108	19
MW-101D	Hexavalent Chromium	01/16 - 10/19	15 / 15	2.6 - 6.8	4.6	4.4	1.3	UP	0.003	57
MW-104S1	Hexavalent Chromium	10/16 - 10/19	12 / 12	3.1 - 3.7	3.3	3.3	0.17	NST	0.220	12
MW-104S2	Hexavalent Chromium	04/14 - 10/19	12 / 12	2.6 - 3.3	3	3.05	0.2	DWN	0.041	-26
MW-107D	Hexavalent Chromium	04/14 - 10/19	8 / 13	0.24 - 1.9	0.98	0.865	0.54	DWN	0.014	-36
MW-110S	Hexavalent Chromium	04/16 - 12/19	15 / 15	1.9 - 5	4.1	4.2	0.75	NST	0.292	12
MW-111S2	Hexavalent Chromium	07/14 - 10/19	12 / 12	1.9 - 2.6	2.4	2.4	0.22	NST	0.066	-22
MW-112S	Hexavalent Chromium	07/15 - 12/19	13 / 13	2.2 - 3.3	3.1	3.2	0.29	NST	0.450	-3
MW-113S1	Hexavalent Chromium	10/14 - 12/19	13 / 13	2 - 3.2	2.9	2.9	0.3	NST	0.237	-12
MW-113S2	Hexavalent Chromium	01/15 - 10/19	13 / 13	2.5 - 3	2.8	2.9	0.16	DWN	0.009	-38
MW-117S1	Hexavalent Chromium	10/14 - 12/19	14 / 14	0.53 - 3.6	1.2	0.75	0.93	UP	<0.001	58
MW-117S2	Hexavalent Chromium	01/15 - 10/19	12 / 12	1.1 - 1.4	1.2	1.2	0.09	UP	0.037	25
MW-121D	Hexavalent Chromium	10/16 - 10/19	13 / 13	3.5 - 4	3.8	3.8	0.16	NST	0.130	19
MW-123S1	Hexavalent Chromium	01/16 - 10/19	13 / 13	1.6 - 2	1.9	1.9	0.12	DWN	0.002	-45
MW-125S2	Hexavalent Chromium	04/14 - 10/19	12 / 12	1.5 - 1.6	1.6	1.55	0.052	NST	0.236	-10
MW-128S1	Hexavalent Chromium	04/16 - 12/19	14 / 14	2.6 - 12	6.2	6.3	2.5	UP	0.035	34
MW-128S2	Hexavalent Chromium	10/15 - 10/19	12 / 12	2.7 - 3.5	3.1	3.1	0.23	DWN	<0.001	-50
MW-128S3	Hexavalent Chromium	10/15 - 10/19	12 / 12	1.6 - 1.8	1.7	1.7	0.083	DWN	0.003	-39
MW-130S1	Hexavalent Chromium	07/14 - 12/19	13 / 13	2.8 - 4	3.6	3.7	0.32	NST	0.450	-3
MW-130S2	Hexavalent Chromium	04/15 - 12/19	14 / 14	3.3 - 3.9	3.7	3.8	0.14	NST	0.249	-12
MW-133S1	Hexavalent Chromium	10/16 - 10/19	12 / 12	7.3 - 9.4	8.1	7.85	0.6	UP	0.050	25
MW-133S2	Hexavalent Chromium	04/14 - 10/19	11 / 13	0.093 - 0.81	0.32	0.26	0.21	NST	0.357	7
MW-135S1	Hexavalent Chromium	04/15 - 12/19	14 / 14	3.3 - 4.3	3.8	3.8	0.24	DWN	0.035	-33
MW-135S2	Hexavalent Chromium	04/15 - 10/19	17 / 17	0.99 - 3.2	2.4	2.6	0.63	NST	0.074	-36
MW-136S1	Hexavalent Chromium	04/16 - 10/19	12 / 12	3.5 - 4	3.8	3.9	0.18	NST	0.384	5

Table 4

Summary Statistics and Mann-Kendall Test Results for the Last 12 Quarters of Hexavalent Chromium Data
2019 Annual Sampling Program Evaluation
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Well ID	Analyte	Date Range	FOD	Detected Results Summary				Mann-Kendall Test		
				Range	Mean	Median	SD	Result	P-Value	S Value
MW-137S1	Hexavalent Chromium	01/16 - 10/19	14 / 14	4.2 - 4.8	4.5	4.55	0.19	NST	0.082	-26
MW-137S2	Hexavalent Chromium	10/15 - 10/19	13 / 13	4.3 - 4.8	4.6	4.6	0.13	NST	0.475	-2
MW-137S3	Hexavalent Chromium	10/15 - 12/19	14 / 14	1.7 - 11	5.4	4.7	2.6	UP	0.012	42
MW-138S1	Hexavalent Chromium	07/15 - 10/19	12 / 12	4.4 - 5.1	4.9	4.95	0.24	DWN	<0.001	-46
MW-138S2	Hexavalent Chromium	04/14 - 10/19	13 / 13	4.3 - 6.7	4.7	4.5	0.62	NST	0.116	-20
MW-139S1	Hexavalent Chromium	07/15 - 10/19	12 / 12	3.5 - 4.7	4.1	4.05	0.42	DWN	<0.001	-61
MW-139S2	Hexavalent Chromium	04/14 - 10/19	13 / 13	0.51 - 2.2	1.3	1.2	0.42	DWN	0.002	-46
MW-140S1	Hexavalent Chromium	07/15 - 12/19	13 / 13	4.2 - 4.9	4.7	4.7	0.18	NST	0.375	6
MW-140S2	Hexavalent Chromium	04/14 - 10/19	12 / 12	3.6 - 4.2	3.9	4	0.17	DWN	0.003	-39
MW-140S3	Hexavalent Chromium	04/14 - 10/19	12 / 12	3.2 - 3.6	3.5	3.5	0.12	DWN	0.035	-26
MW-141D	Hexavalent Chromium	01/14 - 10/19	8 / 12	0.07 - 1.2	0.6	0.665	0.37	DWN	0.029	-28
MW-141S1	Hexavalent Chromium	04/14 - 10/19	14 / 14	2.9 - 3.8	3.4	3.45	0.24	NST	0.456	-3
MW-141S2	Hexavalent Chromium	07/15 - 10/19	13 / 13	3.8 - 4.2	4	4	0.11	DWN	0.036	-29
MW-142S1	Hexavalent Chromium	01/15 - 10/19	12 / 12	2.7 - 5.7	4.3	4.45	0.98	DWN	<0.001	-49
MW-142S2	Hexavalent Chromium	07/15 - 10/19	12 / 12	2.6 - 3.3	3	3	0.19	NST	0.265	-10
MW-142S3	Hexavalent Chromium	01/14 - 10/19	12 / 12	2.7 - 2.9	2.8	2.85	0.094	NST	0.530	0
MW-153S	Hexavalent Chromium	04/16 - 12/19	14 / 14	2 - 3.9	3.3	3.45	0.55	NST	0.148	-20
MW-154S1	Hexavalent Chromium	01/17 - 10/19	12 / 12	5.7 - 9.4	7.3	7.2	0.96	NST	0.065	-23
MW-154S2	Hexavalent Chromium	10/15 - 10/19	12 / 12	1.5 - 2.2	1.9	2	0.19	NST	0.195	13
MW-161S1	Hexavalent Chromium	01/15 - 10/19	12 / 12	3.3 - 3.5	3.4	3.4	0.074	DWN	0.003	-37
MW-161S2	Hexavalent Chromium	04/16 - 10/19	13 / 13	2.7 - 3.4	3.1	3.1	0.21	NST	0.377	-6
MW-161S3	Hexavalent Chromium	01/14 - 10/19	11 / 12	0.55 - 1.6	1.2	1.3	0.33	NST	0.095	-20
MW-162S1	Hexavalent Chromium	10/15 - 10/19	13 / 13	3.4 - 4.2	3.9	3.9	0.22	DWN	0.002	-47
MW-162S3	Hexavalent Chromium	01/14 - 10/19	8 / 12	0.061 - 0.42	0.29	0.305	0.12	NST	0.444	3
MW-173D	Hexavalent Chromium	01/14 - 10/19	12 / 12	0.54 - 0.88	0.71	0.74	0.12	NST	0.085	21
MW-173S1	Hexavalent Chromium	02/17 - 10/19	14 / 14	3.3 - 4.6	3.8	3.65	0.34	NST	0.478	2
MW-173S2	Hexavalent Chromium	04/14 - 10/19	12 / 12	2.6 - 3.1	2.9	2.95	0.16	NST	0.085	20
MW-174S1	Hexavalent Chromium	10/16 - 10/19	12 / 12	3.1 - 3.5	3.4	3.3	0.12	NST	0.383	5
MW-174S3	Hexavalent Chromium	04/14 - 10/19	13 / 13	2.4 - 2.7	2.6	2.6	0.09	DWN	0.025	-31
MW-175D	Hexavalent Chromium	04/14 - 10/19	13 / 13	2.4 - 3.2	2.7	2.7	0.21	NST	0.113	-20
MW-175S1	Hexavalent Chromium	07/15 - 10/19	12 / 12	3 - 3.3	3.2	3.2	0.09	NST	0.383	-5
MW-175S2	Hexavalent Chromium	04/14 - 10/19	12 / 12	2.7 - 3.3	3.1	3.1	0.16	DWN	0.027	-28
MW-184S1	Hexavalent Chromium	07/15 - 10/19	13 / 13	1.5 - 2.7	2	1.9	0.33	UP	0.037	30

Table 4

Summary Statistics and Mann-Kendall Test Results for the Last 12 Quarters of Hexavalent Chromium Data
 2019 Annual Sampling Program Evaluation
 Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Well ID	Analyte	Date Range	FOD	Detected Results Summary				Mann-Kendall Test		
				Range	Mean	Median	SD	Result	P-Value	S Value
MW-184S2	Hexavalent Chromium	04/14 - 10/19	14 / 14	2.5 - 4.2	3.3	3.25	0.47	UP	0.004	49
MW-184S3	Hexavalent Chromium	01/16 - 10/19	13 / 13	4.5 - 4.9	4.7	4.7	0.1	NST	0.474	2
MW-185S1	Hexavalent Chromium	07/15 - 10/19	12 / 12	4.2 - 5.9	4.9	4.8	0.42	DWN	0.006	-37
MW-185S2	Hexavalent Chromium	04/14 - 10/19	15 / 15	2.7 - 4.1	3.6	3.7	0.33	NST	0.362	-8
MW-185S3	Hexavalent Chromium	01/14 - 10/19	12 / 12	3.4 - 4.4	3.9	3.9	0.26	NST	0.079	-21
MW-186S1	Hexavalent Chromium	10/15 - 10/19	12 / 12	4.2 - 5.3	4.8	4.7	0.3	NST	0.146	-16
MW-186S2	Hexavalent Chromium	04/14 - 12/19	19 / 19	1.4 - 3.7	2.7	3.1	0.86	UP	0.023	58
MW-186S3	Hexavalent Chromium	07/16 - 12/19	16 / 16	3.8 - 4.3	4.1	4	0.13	NST	0.519	0
MW-188S1	Hexavalent Chromium	07/15 - 10/19	12 / 12	6.4 - 7	6.8	6.85	0.19	NST	0.241	-11
MW-188S2	Hexavalent Chromium	01/14 - 10/19	13 / 13	0.82 - 3.3	2.3	2.7	0.83	NST	0.356	7
MW-188S3	Hexavalent Chromium	04/14 - 10/19	14 / 14	4.2 - 4.7	4.5	4.5	0.15	NST	0.365	-7
MW-193S1	Hexavalent Chromium	01/16 - 12/19	14 / 14	3.9 - 4.6	4.4	4.4	0.18	NST	0.500	-1
MW-193S2	Hexavalent Chromium	10/15 - 10/19	13 / 13	3.2 - 11	4.7	4	2	DWN	0.042	-29
MW-193S3	Hexavalent Chromium	01/16 - 10/19	10 / 15	0.31 - 6.7	1.8	0.925	2.1	DWN	0.019	-42
MW-194S1	Hexavalent Chromium	10/15 - 12/19	13 / 13	2.8 - 5.9	4.8	4.9	0.85	NST	0.063	-26
MW-194S2	Hexavalent Chromium	01/14 - 10/19	11 / 14	0.11 - 4.9	1.4	0.33	1.8	DWN	0.035	-34
MW-194S3	Hexavalent Chromium	04/14 - 10/19	9 / 12	0.085 - 2.1	0.71	0.58	0.62	NST	0.500	1
MW-195S1	Hexavalent Chromium	07/15 - 10/19	12 / 12	3.5 - 5.2	4.8	4.9	0.48	NST	0.528	0
MW-195S2	Hexavalent Chromium	04/14 - 10/19	12 / 12	3.7 - 4.6	4.2	4.2	0.25	DWN	0.004	-39
MW-195S3	Hexavalent Chromium	01/14 - 12/19	14 / 15	0.58 - 3.4	1.6	1.5	0.74	NST	0.244	-15
MW-196S1	Hexavalent Chromium	07/14 - 10/19	49 / 49	3.6 - 14	8.6	9	3.5	DWN	0.004	-313
MW-196S2	Hexavalent Chromium	07/16 - 10/19	12 / 12	2.4 - 4	3.1	3.15	0.63	NST	0.528	0
MW-200S3	Hexavalent Chromium	07/14 - 10/19	12 / 12	0.37 - 0.77	0.52	0.485	0.13	UP	<0.001	54
MW-203D	Hexavalent Chromium	04/16 - 12/19	15 / 15	0.24 - 6.5	2.3	1.6	1.8	NST	0.364	8
MW-204D	Hexavalent Chromium	04/14 - 10/19	12 / 12	0.33 - 0.67	0.55	0.575	0.11	NST	0.473	-2
MW-204S1	Hexavalent Chromium	04/15 - 10/19	12 / 12	3 - 3.4	3.2	3.25	0.13	DWN	0.039	-26
MW-204S2	Hexavalent Chromium	01/16 - 10/19	12 / 12	3.5 - 4.2	3.9	3.85	0.21	NST	0.056	-24
MW-205S1	Hexavalent Chromium	04/16 - 10/19	13 / 13	2.5 - 4	3.2	3.2	0.54	NST	0.269	11
MW-205S2	Hexavalent Chromium	01/15 - 10/19	14 / 14	2.6 - 4.2	3.8	3.8	0.38	NST	0.434	-4
MW-205S3	Hexavalent Chromium	07/15 - 10/19	12 / 12	3.5 - 4.4	3.9	3.85	0.25	DWN	0.001	-44
MW-207S1	Hexavalent Chromium	07/16 - 10/19	12 / 12	5.4 - 7.3	6.6	6.6	0.52	DWN	0.013	-33
MW-207S2	Hexavalent Chromium	01/17 - 12/19	13 / 13	3.1 - 4.1	3.6	3.6	0.25	UP	0.001	49
MW-212S1	Hexavalent Chromium	04/16 - 10/19	13 / 13	2.7 - 3.4	3.2	3.2	0.18	NST	0.217	-13

Table 4

Summary Statistics and Mann-Kendall Test Results for the Last 12 Quarters of Hexavalent Chromium Data
 2019 Annual Sampling Program Evaluation
 Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Well ID	Analyte	Date Range	FOD	Detected Results Summary				Mann-Kendall Test		
				Range	Mean	Median	SD	Result	P-Value	S Value
MW-212S2	Hexavalent Chromium	10/15 - 12/19	16 / 16	1.3 - 3.2	2.4	2.5	0.57	NST	0.052	-37
MW-213S	Hexavalent Chromium	01/17 - 10/19	14 / 14	3.3 - 5.4	4.4	4.35	0.75	DWN	<0.001	-59
MW-219S1	Hexavalent Chromium	03/17 - 10/19	13 / 13	2.4 - 4	3.3	3.3	0.47	UP	0.016	36
MW-219S2	Hexavalent Chromium	12/16 - 10/19	7 / 9	Not enough data						
MW-221S	Hexavalent Chromium	06/18 - 10/19	8 / 8	Not enough data						
MW-49S	Hexavalent Chromium	04/16 - 10/19	13 / 13	2.8 - 5.2	4	4	0.53	NST	0.068	-25
MW-50B	Hexavalent Chromium	10/16 - 10/19	12 / 12	2.8 - 8.2	6.1	6.65	1.9	UP	0.037	27
MW-66A	Hexavalent Chromium	10/16 - 10/19	12 / 12	3.4 - 4.1	3.8	3.75	0.21	NST	0.244	-11
MW-72S	Hexavalent Chromium	07/16 - 10/19	12 / 12	4.5 - 5.7	5.1	4.9	0.4	NST	0.093	20
MW-79S	Hexavalent Chromium	01/17 - 12/19	13 / 13	6 - 7.7	6.4	6.2	0.48	NST	0.061	26
MW-80S	Hexavalent Chromium	02/17 - 10/19	14 / 16	0.34 - 9.8	3.9	3.25	2.8	DWN	0.012	-51
MW-87S	Hexavalent Chromium	04/16 - 10/19	12 / 12	2.2 - 3.7	3	3.1	0.51	NST	0.108	-19
MW-94D	Hexavalent Chromium	04/15 - 10/19	14 / 14	2.1 - 4.7	3.4	3.55	0.75	NST	0.500	-1
MW-94S	Hexavalent Chromium	07/15 - 10/19	12 / 12	5.6 - 7	6.3	6.35	0.39	NST	0.418	4
MW-95S	Hexavalent Chromium	07/15 - 10/19	12 / 12	6.4 - 8.6	8.1	8.2	0.57	DWN	<0.001	-51
MW-97S	Hexavalent Chromium	07/16 - 12/19	18 / 18	4 - 8.2	6	5.85	1	NST	0.366	10

Table 4

**Summary Statistics and Mann-Kendall Test Results for the Last 12 Quarters of Hexavalent Chromium Data
2019 Annual Cleanup Status and Effectiveness Report
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California**

Notes:

1. All results are in micrograms per liter ($\mu\text{g/L}$). Values less than 10 are reported to 2 significant figures. Values greater than 10 are reported to 3 significant figures.
2. Trend results are presented when at least four samples and one detected value are available.
3. Nondetects were assigned a common value less than the minimum detected value (95% of the minimum detected value) (USEPA 2009).

Abbreviations:

DWN = decreasing trend
FOD = frequency of detection (number of detects / number of samples)
mean = arithmetic mean
NST = no significant trend
SD = standard deviation
UP = increasing trend

Reference:

USEPA. 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance. United States Environmental Protection Agency Office of Resource Conservation and Recovery. EPA 530/R-09-007. March.

Table 5

Summary of Data from Last Four Quarters

for Wells Decreasing from Semiannual to Annual Sampling

2019 Annual Sampling Program Evaluation

Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California



ARCADIS

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Location	Date	Cr(VI) Concentration µg/L
MW-105S	4/3/2019	2.6
MW-105S	7/9/2019	3
MW-105S	9/3/2019	3
MW-105S	10/10/2019	2.8
MW-106S	7/10/2018	2.9
MW-106S	10/10/2018	2.9
MW-106S	4/3/2019	3
MW-106S	10/14/2019	3
MW-111S1	10/18/2017	2.4
MW-111S1	10/10/2018	2.4
MW-111S1	4/3/2019	2.5
MW-111S1	10/10/2019	2.3
MW-123S2	10/4/2017	1.9
MW-123S2	10/3/2018	1.9
MW-123S2	4/1/2019	2
MW-123S2	10/10/2019	1.9
MW-124D	10/6/2017	0.77
MW-124D	10/3/2018	0.84
MW-124D	4/1/2019	0.96
MW-124D	10/10/2019	0.98
MW-125S1	4/5/2018	2.1
MW-125S1	10/3/2018	2.1
MW-125S1	4/10/2019	2.2
MW-125S1	10/10/2019	2.1
MW-131S1	10/13/2017	2.7
MW-131S1	10/9/2018	2.5
MW-131S1	4/2/2019	2.6
MW-131S1	6/6/2019	2.4
MW-131S1	10/8/2019	2.2
MW-131S1	12/4/2019	2.6
MW-156S	10/2/2017	0.61
MW-156S	10/16/2018	0.46
MW-156S	4/10/2019	0.7
MW-156S	10/7/2019	0.81

Table 5

Summary of Data from Last Four Quarters

for Wells Decreasing from Semiannual to Annual Sampling

2019 Annual Sampling Program Evaluation

Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California



ARCADIS

Design & Consultancy
for natural and
built assets

Location	Date	Cr(VI) Concentration µg/L
MW-157S	10/2/2017	1.6
MW-157S	10/16/2018	1.4
MW-157S	12/3/2018	1.6
MW-157S	4/10/2019	1.6
MW-157S	10/7/2019	1.5
MW-166S1	4/4/2018	0.22
MW-166S1	10/18/2018	< 0.2
MW-166S1	4/3/2019	< 0.2
MW-166S1	10/8/2019	0.46
MW-171S	4/6/2018	2.2
MW-171S	10/17/2018	2.2
MW-171S	4/1/2019	2.2
MW-171S	10/10/2019	1.7
MW-171S	12/5/2019	2.1
MW-174S2	10/12/2017	2.4
MW-174S2	10/18/2018	2.4
MW-174S2	4/2/2019	2.2
MW-174S2	6/6/2019	2.4
MW-174S2	10/8/2019	2.2
MW-197S1	4/4/2018	1.1
MW-197S1	10/5/2018	1.1
MW-197S1	4/16/2019	1.7
MW-197S1	10/9/2019	1.4
MW-200S1	1/26/2018	0.87
MW-200S1	3/8/2018	0.71
MW-200S1	10/4/2018	0.81
MW-200S1	4/8/2019	0.76
MW-200S1	10/23/2019	0.88

Abbreviations:

Cr(VI)= hexavalent chromium

µg/L = micrograms per liter

< = less than reporting limit listed

Table 6

Summary of Data from Last Four Quarters

for Wells Decreasing from Annual to Biennial Sampling

2019 Annual Sampling Program Evaluation

Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Location	Date	Cr(VI) Concentration µg/L
MW-113D	10/12/2016	< 0.2
MW-113D	10/18/2017	< 0.2
MW-113D	10/9/2018	< 0.2
MW-113D	10/9/2019	< 0.2

Abbreviations:

Cr(VI)= hexavalent chromium

µg/L = micrograms per liter

< = less than reporting limit listed

APPENDIX D

Four-Year Remedial Timeframe Assessment Update




Pacific Gas and Electric Company

APPENDIX D: FOUR-YEAR REMEDIAL TIMEFRAME ASSESSMENT UPDATE

Hinkley Compressor Station
Hinkley California

Cleanup and Abatement Order
No. R6V-2015-0068

March 30, 2020

A large, solid orange geometric shape, resembling a stylized triangle or a section of a larger triangle, is positioned in the bottom right corner of the page. It is composed of two overlapping triangles, creating a complex, angular form that extends from the bottom edge towards the top right corner.

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APPENDIX D: FOUR-YEAR REMEDIAL TIMEFRAME ASSESSMENT UPDATE

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ACRONYMS AND ABBREVIATIONS

µg/L	microgram per liter
ATU	Agricultural Treatment Unit
2015 CAO	Cleanup and Abatement Order No. R6V-2015-0068, issued November 4, 2015
Cr(VI)	hexavalent chromium
ft	feet
IRZ	In Situ Reactive Zone
mg/L	milligram per liter
MTC	mass transfer coefficient
PG&E	Pacific Gas and Electric Company
RTA	Remedial Timeframe Assessment
SCRIA	South Central Reinjection Area
TOC	total organic carbon
USGS	U.S. Geological Survey
Water Board	California Regional Water Quality Control Board, Lahontan Region

1 INTRODUCTION

Pacific Gas and Electric Company (PG&E) is submitting this Four-Year Remedial Timeframe Assessment (Updated RTA) to comply with California Regional Water Quality Control Board, Lahontan Region (Water Board) Cleanup and Abatement Order No. R6V-2015-0068, issued November 4, 2015 (2015 CAO; Water Board 2015), for the Hinkley Compressor Station located in Hinkley, California (the site). Every four years, the 2015 CAO requires that a Four-Year Comprehensive Cleanup Status and Effectiveness Report (report) be submitted. The 2015 CAO also requires that data from the last four years be used to update the groundwater modeling. The updated groundwater modeling is then used to evaluate the progress to reach target chromium concentrations by the associated deadlines. This Updated RTA presents the four-year update to the groundwater models as required in the 2015 CAO.

2 BACKGROUND: 2014 RTA

In 2014, an RTA was completed to develop a range of remedial timeframes for groundwater cleanup and to characterize the certainty of timeframe estimates (Arcadis 2014). The modeling effort produced a range of outcomes from various model layers representing variability in hydrogeologic conditions encountered at the site, as well as two different modeling scenarios. Table D-1 summarizes the modeling scenarios presented in the RTA. Scenario 1 in the RTA was a carryover of remedial assumptions for Alternative 4C-2 in the Feasibility Study (Haley and Aldrich 2011). RTA Scenarios 2 and 3 were used to bracket the range of results observed in the field through 2014 by varying the amount of organic carbon distribution that was sufficient for hexavalent chromium (Cr[VI]) reduction. Scenario 2 was the faster scenario, and is referred to herein as the RTA Fast Scenario 2 (low organic carbon threshold). Scenario 3 was slower (order of magnitude higher organic carbon threshold), and is referred to herein as RTA Slow Scenario 3.

The range of timeframes estimated in the RTA is presented in Table D-2. From the two models (RTA Fast Scenario 2 and RTA Slow Scenario 3), estimates for cleanup ranged from 6 to 23 years (i.e., complete in 2021 to 2038) to remediate 99 percent of the 50-microgram per liter ($\mu\text{g/L}$) southern plume; and 7 to 50 years to remediate 99 percent of the 10 $\mu\text{g/L}$ southern plume (i.e., complete in 2026 to 2065). Finding 22 of the 2015 CAO stated that estimated timeframes from the RTA informed the cleanup timelines incorporated into the 2015 CAO (Water Board 2015). The deadlines incorporated into the 2015 CAO are sooner than the range of estimates provided in the RTA with the cleanup timeframe for 90 percent of the 50 $\mu\text{g/L}$ area set for 2025 (10 years) and the cleanup timeframe for 80 percent of the 10 $\mu\text{g/L}$ area set for 2032 (17 years).

The RTA and Finding 22 of the 2015 CAO also recognized that the timeframe estimates were uncertain given “underlying, simplified assumptions in the modeling, uncertainty in conditions throughout the modeled aquifer, operational and construction uncertainties and assumptions made on the timing and continuation of permitting for the project” (Water Board 2015). The RTA noted that the modeling estimates were intended to guide for evaluation of remedy performance over time, did not provide definitive predictions for remedy timeframe, and should not be used with the expectation of certainty (Arcadis 2014).

3 SUMMARY OF THE GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

A complete description of the groundwater flow and solute transport models used was presented in the Feasibility Study, Addendum 3 (Arcadis and CH2M HILL 2011). A summary is provided here for reference.

The groundwater flow model was designed to represent groundwater conditions over approximately 25 square miles of Hinkley Valley. The model domain extends approximately 5 miles in the north-south direction, from about 4,000 feet (ft) south of the PG&E compressor station to Red Rock Canyon, 4.5 miles north. The model is about 5 miles wide at the compressor station, extending 2 miles to the west and 3 miles to the east. The model domain narrows to the north of the compressor station to follow the structure of the basin. The model contains 610 rows, 425 columns, and six layers and includes a total of 1,483,990 active cells. The minimum cell size is 25 by 25 ft, occurring throughout most of the defined Cr(VI) plume south of Thompson Road. The largest sized cells are 500 by 1,000 ft. These larger cell sizes are located at the periphery of the model domain.

Individual model layers were used to represent each of the significant hydrogeologic units. In general, layers 1 through 3 represent the Upper Aquifer, with layer 2 representing the low-transmissivity layer (where present) that divides the Upper Aquifer in places, particularly north of the Santa Fe Road (e.g., the “brown clay”). South of Santa Fe Road, where the brown clay layer is not present, layer 2 represents lower-permeability deposits within the Upper Aquifer. The bottoms of layers 3 and 4 represent the top and bottom of the blue clay where present, respectively. The bottoms of layers 4 and 5 represent the top and bottom of the Lower Aquifer, where present, respectively. The bottom of layer 5 represents the top of the bedrock contact, except in areas of bedrock outcropping within the model domain. Model layer 6 represents the competent bedrock. RTA modeling focuses on layers 1, 2, and 3, which comprise the Upper Aquifer where a majority of the Cr(VI) plume resides.

The boundaries of the groundwater flow model are specified to coincide with natural hydrogeologic boundaries, where possible, and the boundaries were set at a significant distance from the site to minimize the influence of model boundaries on simulation results at the site. The simulation program MODFLOW was selected for the construction and calibration of the numerical groundwater flow model at the site. MODFLOW is a publicly available groundwater flow simulation program developed by the U.S. Geological Survey (McDonald and Harbaugh 1988). MODFLOW is thoroughly documented; widely used by consultants, government agencies, and researchers; and is consistently accepted in regulatory and litigation proceedings. Additional details on the groundwater flow model construction, boundary conditions, hydraulic parameters, and calibration are provided in Appendix G to the Feasibility Study, Addendum 3 (Arcadis and CH2M HILL 2011 in Haley and Aldrich 2011).

4 EVALUATION OF ACTUAL RESULTS VERSUS MODELING RESULTS, 2016 TO 2019

The 2015 CAO requires PG&E to update model predictions with data collected during the preceding four years. Accordingly, the groundwater models have been updated in two ways: 1) by comparing actual results to RTA modeled results and adjusting modeling parameters and 2) by updating the baseline distribution of Cr(VI) in the model and updating the forward predictions. The comparison of actual results to RTA modeled results is presented in this section, while the updated future predictions are presented in Section 5.

Figures D-1, D-2, and D-3 present a comparison of actual Fourth Quarter 2019 Cr(VI) distributions in panel A of each figure to RTA Fast Scenario 2 and RTA Slow Scenario 3 predicted Cr(VI) distributions for 2019 in panels B and C. Figure D-1 presents the shallow zone of the Upper Aquifer and corresponding model layer 1. Figures D-2 and D-3 present the lower zone of the Upper Aquifer versus model layers 2 and 3, respectively. A comparison of Fourth Quarter 2019 actual Cr(VI) distribution to model-predicted Cr(VI) distributions revealed that the groundwater model predicted greater areas of treatment by Fourth Quarter 2019, four years into the 2015 CAO, than was observed (Figures D-1, D-2, and D-3). The comparison indicated four main reasons for the difference in model predictions versus actual results:

1. Areas of the plume characterized since 2015 through proactive investigations resulting in additional areas or mass to treat;
2. Differences between actual operations and model assumptions;
3. Overprediction of the area of organic carbon distribution and stimulation of in-situ reactive zones in the model; and
4. Slower actual treatment than predicted in several higher concentration areas.

In addition, a portion of the aquifer has dewatered due to the ongoing drought in the shallow zone near the intersection of Community Boulevard and Fairview Road, as shown on Figure D-1. The original RTA preserved mass in this portion of the aquifer, although the saturated thickness in this area is currently limited to a few feet or less due to nearly a decade of drought conditions in the greater Hinkley area (See Section 4 of the main report).

As discussed in the report, in the last four years, significant progress has been made toward understanding plume conditions. Proactive investigations characterized elevated concentrations of Cr(VI) greater than 1,000 µg/L under the compressor station (labeled with a #1 on Figures D-1 and D-4), greater than 100 µg/L in the Western In Situ Reactive Zone (IRZ) area (labeled with a #2 on Figures D-1 and D-4), and greater than 1,000 µg/L in the Deep East South Central Reinjection Area (SCRIA, labeled with a #3 on Figures D-2, D-3, and D-5), as well as an area of greater than 1,000 µg/L just north of Community Boulevard that was revealed with the installation of MW-208 for the southern Agricultural Treatment Units (ATUs) in 2014 (labeled with a #3 on Figures D-1 and D-4). The baseline plume used in the RTA did not account for the elevated Cr(VI) concentrations in these areas, which were not known at the time of the RTA modeling, as shown on Figures D-4 and D-5. Additional remedial infrastructure has been implemented or is planned to address these areas, as discussed in the report. Although the RTA had

APPENDIX D: FOUR-YEAR REMEDIAL TIMEFRAME ASSESSMENT UPDATE

recognized, as a model uncertainty, that the model cannot fully describe the heterogeneity in the Cr(VI) distribution (Arcadis 2014), it is important to note that the RTA modeling results for the first four years did not account for these newly discovered areas of elevated Cr(VI) concentrations or the implemented and/or planned improvements made in response to these elevated concentrations. Accordingly, the modeling used by the Water Board to inform the cleanup timeframes in the 2015 CAO likewise did not account for these elevated concentration areas or improvements.

The difference in the modeling results versus actual observations was in small part due to differences between the assumed operating conditions in the modeling versus actual operations. Table D-3 summarizes the operating assumptions in the RTA versus actual operations. Actual operations are planned out annually and submitted to the Water Board per 2015 CAO requirement VI.B. Actual operations are tracked and compared to planned operations, and the Water Board is notified when operations are greater than 10 percent lower than planned. As shown in Table 2-2 of the report, operational goals were routinely met in the last four years, with a few exceptions (noted in the table) where operations were reduced for various reasons such as crop health, ponding prevention, construction, and when operations were limited by fouling.

Simplifying assumptions for injection intervals and well rotations were used in the RTA modeling compared to actual implementation. In actual operations, wells were operated in discreet intervals. For instance, targeting the shallow or deep zone of the Upper Aquifer individually, as the effectiveness of injections was improved by depth-discreet injections. Actual injection rates and organic carbon injection concentrations were lower than the modeling assumptions due to a combination of factors including lower injectability of the formation compared to what was input into the model, piping limitations that required upgrades to recirculate greater flows of water to injection wells, and injection well fouling.

In the northeast SCRIA, construction planned for 2019 was delayed due to presence of habitat and delays in obtaining necessary agency wildlife permits. Actual operating conditions from 2015 to 2019 were simulated to evaluate how the difference between actual operations and simplified RTA operational assumptions influenced modeling predictions. In this simulation, referred to as Actual Rates Slow Scenario 3B, actual operations (as summarized in Table D-3) and the same modeling parameters of RTA Slow Scenario 3 were used, except that treatment capacity was modeled to last for two years following the dissipation of organic carbon. This feature was added because it was observed in modeling that treated areas rebounded immediately when residual reducing capacity was not built into the model, while several years of treatment following carbon injections are observed in actual results.

The results of Actual Rates Slow Scenario 3B are presented on panel D on Figures D-1, D-2, and D-3. Comparing the actual rates on panel D to the RTA assumed rates in panels B and C on these figures shows a few small areas where less treatment was predicted compared with actual rates: the intersection of Community Boulevard and Fairview Road in the shallow zone on Figure D-1 (labeled #4) and the northeastern SCRIA in the deep zone on Figures D-2 and D-3 (labeled #5). However, the model continued to overpredict treatment from IRZ injection wells in some areas where initial Cr(VI) concentrations were higher than 500 and 1,000 µg/L. Examples of these areas include the Deep East SCRIA (labeled #6 on Figures D-2 and D-3) and the northern portion of the Source Area along Community Boulevard (labeled #7 on Figures D-1, D-2, and D-3).

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Further evaluation of the modeling parameters and results revealed two key observations for potential improvement in model predictions. The first observation was that the model was overpredicting the downgradient footprint of organic carbon distribution and, therefore, the downgradient length of the IRZ where Cr(VI) is directly reduced and immobilized as trivalent chromium. In observed data, Cr(VI) concentrations are directly reduced by IRZs within 100 to 200 ft downgradient of injection well transects, and Cr(VI) concentrations in between injection transect IRZs decrease by the flux of treated water from the upgradient transect flushing Cr(VI) into the subsequent downgradient treatment IRZ. In the RTA model, sufficient organic carbon to stimulate active IRZ reduction of Cr(VI) was simulated to be distributed more than 500 ft, in many cases covering the entire distance between injection transects. Example carbon footprints illustrating this point are provided on Figure D-6 output from the RTA Slow Scenario 3 from the simulation point representing the Third Quarter 2015. On this figure, the Cr(VI) within the green areas representing total organic carbon (TOC) at concentrations higher than 1 milligram per liter (mg/L) would have been treated to less than 3.1 µg/L as soon as the TOC reached this distribution. What actually occurs is a steady but slow decline in Cr(VI) concentrations due to flushing of upgradient treated water; this is particularly evident in areas where initial Cr(VI) concentrations were higher than 500 and 1,000 µg/L (see Section 6 of the report).

Because of this difference between model assumptions and actual behavior of Cr(VI) reduction in relation to TOC distribution, the RTA modeling predicted rapid direct treatment of Cr(VI) between transects versus the slower and steady decreasing concentrations that occur due to flushing. In addition, the modeling predicted flushing would decrease higher concentration areas more rapidly than has occurred. For example, a portion of the northern Source Area with Cr(VI) concentrations greater than 500 µg/L just south of Community Boulevard (shown as #8 on panel A of Figures D-2 and D-3) was predicted to be almost entirely treated by the model (panels B, C, and D); however, this is not occurring.

To address disagreement between the observed Cr(VI) distribution and the model simulated results, a new set of input parameters was used to create Updated Slower Scenario 4 (Scenario 4). Scenario 4 was assembled by: 1) increasing the trigger TOC concentration for Cr(VI) reduction to 10 mg/L and 2) including an adaptive mass transfer coefficient (MTC) proportional to groundwater velocity rather than a fixed MTC. The MTC was assigned based on current understanding of how the hydrogeology affects this parameter. The MTC used in dual-domain transport is a hydraulic parameter that varies proportionally as groundwater flow changes due to variations in model structure (grid dimensions), hydraulic parameters, and boundary conditions. A multi-rate MTC was applied with a constant upscaling parameter. This procedure adjusts the MTC values in each cell based on the groundwater flux; the MTC increases with faster groundwater flow. As pumping distribution varies throughout the model domain during the model runs, the MTC can now be dynamically assigned.

The MTC calculation procedures outlined by Potter et al. (2018) and Guo et al. (2020) were used to calculate the MTC throughout the model domain. In addition, two years of residual reducing capacity representing the treatment that occurs after organic carbon is degraded was added to Scenario 4. Results of the Updated Scenario 4 are shown in panel E of Figures D-1, D-2, and D-3. The results of the new parameters improved the model performance for some areas of the site; however, the model predicted higher concentrations than observed in other areas of the site. In the shallow zone, Cr(VI) concentrations more consistent with observed conditions were predicted in the west along Fairview Road (labeled #9 on panel E of Figure D-1). In the deep zone (panel E of Figures D-2 and D-3), several areas of mass more

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consistent with observed conditions were predicted in Scenario 4, although not consistently across model layers 2 and 3 as follows:

- Mass in the deep zone on the eastern side of the Source Area just south of Community Boulevard (labeled with a #10 on Figures D-2 and D-3), although this improvement was only observed in model layer 2 predictions (Figure D-2) and not in model layer 3 predictions (Figure D-3).
- Mass in the eastern SCRIA was preserved in Scenario 4 (labeled #5 on Figures D-2 and D-3), but the model predicted more Cr(VI) than is currently contoured in this area in model layer 2. The model also underpredicted the IRZ performance in this area in model layer 2.
- Mass just north of Community Boulevard on the western side of the plume (labeled #11 on Figures D-2 and D-3), although higher Cr(VI) concentrations than actual were predicted in this area in model layer 2 (Figure D-2).

Scenario 4 (panel E) underpredicted treatment by the IRZs in several areas:

- Downgradient of the Central Area in model layers 1 and 2 (labeled # 12 on Figures D-1 and D-2).
- Across model layer 2, as seen by comparing the white areas on panel E with panel A on Figure D-2.

Scenario 4 also continued to overpredict treatment between the northern line of injection wells (south of Community Boulevard) and Community Boulevard (labeled #7 on Figures D-1, D-2, and D-3).

In summary, the RTA Fast Scenario 2 greatly overpredicted actual performance; the RTA Slow Scenario 3 better matched actual results than the RTA Fast Scenario 2, but still overpredicted performance downgradient; and Scenario 4 improved on downgradient performance in many areas and preserved Cr(VI) mass better in some areas, but predicted higher Cr(VI) concentrations in some areas than are actually observed.

5 UPDATED FUTURE MODELING

Modeling predictions for reaching remedial timeframes in the 2015 CAO were updated. Because none of the modeling scenarios completely matches all of the aspects of actual performance, both the RTA Slow Scenario 3B and the Updated Scenario 4 were run to provide a range of estimates. The Cr(VI) concentration distribution from the Fourth Quarter of 2019 was used to initialize the model, incorporating the improved understanding of plume conditions derived from the last four years from proactive investigations. The operating assumptions in the model input were based on actual well rotations, flow rates, target depth intervals, and TOC concentrations implemented over the last four years, as summarized in Table D-3. The existing and proposed remedial infrastructure relative to the fourth quarter 2019 Cr(VI) concentration distributions are shown on Figure D-7. Remedial infrastructure assumed in the modeling consisted of wells that have already been constructed, as well as the current expansion plans previously proposed, including:

- Injection into IRZ converted extraction wells north of Western Community Boulevard (Arcadis 2019a) (labeled #1 on Figure D-7);
- Construction of an expanded Western IRZ per the basis of design submitted on June 6, 2019 (Arcadis 2019b), assuming the Water Board issues a revised IRZ Notice of Applicability in 2020 and construction and operation by 2021 (labeled #2 on Figure D-7);
- Construction of a set of injection wells in the northeastern corner of the SCRIA per the original design (Arcadis 2014) and operation by 2021 (labeled #3 on Figure D-7); and
- A remedy on the compressor station in accordance with the design notification submitted on October 11, 2019 (Arcadis 2019c) with Phase 1 extraction implemented in early 2020 and Phase 2 injection implemented in 2022 (labelled #4 on Figure D-7).

The 2015 CAO goal for the 50 µg/L plume is to reach 50 µg/L across 90 percent of the plume by 2025. Modeling predictions for 2025 are shown on Figure D-8 for the Actual Rates Slow Scenario 3B and on Figure D-9 for Scenario 4. The updated modeling results show a range of predictions for 2025, as summarized in Table D-5, with the Actual Rates Slow Scenario 3B predicting achievement of 50 µg/L concentrations across 90 to 97 percent of the plume area and Scenario 4 predicting achievement of 50 µg/L concentrations across 68 to 87 percent of the plume area.¹ The results of this modeling indicate that the full attainment of the 50 µg/L plume goal might not be reached by the 2025 target due to several factors:

- Potentially relatively slow treatment of mass in the deep east SCRIA (labelled with #1 on Figure D-9). This area was observed to be slow to treat, and additional activities to investigate and add considerable infrastructure were conducted in 2017 to 2019 to improve performance. Operation of the new infrastructure began in 2019 (See Section 6.2.1 of the report for details). These areas were revealed through proactive investigation after the original modeling was conducted that informed the 2015 CAO timeframes. The new infrastructure has already improved performance of this area and is

¹ Percent complete assumes that the 12 percent of the plume area in the shallow zone that is currently dewatered due to drought remains dewatered.

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expected to further improve treatment; however, given how difficult this area has been to treat to date, may not be able to completely treat the area to 50 µg/L by 2025.

- A persistent area of mass residing within the shallow zone of the Upper Aquifer (model layer 1) under the current active compressor station surface impoundments results in ongoing plume migration in the north Source Area south of Community Boulevard (labeled #2 on Figures D-8 and D-9).
- Residual 50 µg/L plume in the northeast SCRIA (labeled with a #3 on Figures D-8 and D-9) and the western edge of the IRZ area (labeled with a #4 on Figures D-8 and D-9) due to unexpected delays in obtaining necessary permits from United States Fish & Wildlife Service, California Department of Fish and Wildlife, and the Water Board.
- A gap in the treatment occurs even with the addition of the IRZ wells in the planned western expansion in the SCRIA (labelled #5 on Figures D-8 and D-9).

Overall, updated modeling results indicate that considerable progress toward the 50 µg/L goal will be made by 2025; however, uncertainty in meeting the 2025 deadline remains (Table D-6), with achievement of 50 µg/L across 90 percent of the plume predicted to occur between 2024 and 2035. The low end of the range represents the more optimistic modeling Actual Rates Slow Scenario 3B in the deep zone model layer 3. The high end of the estimate represents a most conservative scenario, combining the least optimistic model inputs (Scenario 4) with the model layer 2 with the most difficult to treat hydrogeologic assumptions. Actual performance is anticipated to fall somewhere in between these predictions.

Together, these results show positive outcomes of the remedial actions taken and anticipated, setting a feasible path for meeting the 50 µg/L goal; however, actual achievement of the 2025 cleanup goal is not certain. Due to underperformance in some areas, enhancements presented in Section 3.3 of the report will be further discussed in the forthcoming work plan, as required by the 2015 CAO. These enhancements, in conjunction with the extra remedy infrastructure installed to date, are expected to maintain the current steady progress toward achieving the 2015 CAO goals of 50 µg/L across 90 percent of the plume by 2025 and 10 µg/L across 80 percent of the plume by 2032; however, even with the currently planned enhancements, 50 µg/L across 90 percent of the plume might not be fully achieved by 2025.

The updated model scenarios predict that the 2015 CAO target for treatment of 80 percent of the 10 µg/L plume will be reached between 2030 and 2058 (Table D-7). These extended timelines of the updated modeling are reasonable given the uncertainty presented in the RTA modeling and the improved understanding of hydrogeological and plume conditions.

Finally, this updated model, like all models, includes simplifying fundamental assumptions and data uncertainties; therefore, this updated model has inherent limitations and uncertainties when used to predict behavior and responses for real systems. The amount of uncertainty associated with these model results is directly related to the degree to which actual site conditions and processes deviate from model assumptions and input parameter values. The numerical model approximates the current conceptual model, which has been developed in the context of available geologic, hydrogeologic, and chemical data. As discussed in Section 3.1 of the report, an improved understanding of the Lockhart Fault system was recently revealed in a study by Dave Miller at the United States Geological Survey (USGS) as part of the chromium background study. The USGS study indicates that there are numerous splays of the Lockhart Fault present throughout the southern plume area (Miller et al. 2018). The hydrogeologic

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influences of these newly identified fault splays within the plume core areas, containing the highest chromium concentrations on site, are just beginning to be understood and were not included in the 2014 groundwater modeling for the RTA or updated scenarios presented herein. When the hydrologic influences of these newly identified fault splays are better understood, they will be incorporated into the groundwater model.

Given the complexity of the hydrogeological conditions of the site, this updated model reasonably reproduces observed groundwater elevations, hydraulic responses for existing conditions, and the impact of remedial activities on the Cr(VI) plume distribution. Therefore, this updated model is useful for evaluating the relative predicted impact of various remedial scenario layouts and conceptual model updates on remediation performance. The influences of aquifer heterogeneities and fault splays on plume behavior, mass removal, reagent delivery, and IRZ performance cannot be described and cannot be fully predicted with the solute transport model. In addition, the model cannot fully describe the heterogeneity in the Cr(VI) distribution and areas where there may be more mass loaded into tighter lithologies or the immobile pore space or areas that may not be in communication with the rest of the aquifer. Such areas may be more difficult to treat or may exhibit rebound after treatment and require additional remediation. As stated in the RTA in 2014 (Arcadis 2014), the modeling analysis presented in RTAs and herein is intended to provide guide evaluation of remedy performance over time. It does not provide definitive predictions for remedy timeframe to meet cleanup goals and should not be used with the expectation of certainty.

6 REFERENCES

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TABLES



Table D-1
Summary of Modeling Scenarios
Appendix D: Four-Year Remedial Timeframe Assessment Update
Four Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

	RTA Scenario 1 and Scenario 2	RTA Scenario 3	Scenario 3B	Scenario 4
Amount of Organic Carbon Required for Cr(VI) Reduction	0.1 mg/L	1 mg/L	1 mg/L	10 mg/L
Mass Transfer Rate Coefficients	Constant	Constant	Constant	Variable
Residual Reducing Capacity	none	none	2 years	2 years

Abbreviations:

Cr(VI) = hexavalent chromium
mg/L = milligrams per liter
RTA = remedial timeframe assessment (Arcadis 2014)

Reference:

Arcadis. 2014. Remedial Timeframe Assessment, PG&E Hinkley Compressor Station, Hinkley, California. June 30.

Table D-2
Summary of RTA Model Estimated Remedial Timeframes
Appendix D: Four-Year Remedial Timeframe Assessment Update
Four Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Scenario	Time to Reduce Total Mass by 80% (years)	Time to Reach 1% of Initial 50-µg/L Contour Area Remaining (Years)			Time to Reach 1% of Initial 10-µg/L Contour Area Remaining (Years)		
		Model Layer 1	Model Layer 2	Model Layer 3	Model Layer 1	Model Layer 2	Model Layer 3
Scenario 1: FS Alternative 4C-2, First Quarter 2014 Baseline	6	6	8	4	7	26	20
RTA Fast Scenario 2	8	10	15	6	11	37	19
RTA Fast Scenario 3	13	13	23	9	17	50	27

Note:

Timeframe estimates are for treatment of the contiguous plume core south of Thompson Road.

Abbreviations:

µg/L- micrograms per liter

FS = feasibility study (Haley and Aldrich 2011)

RTA- remedial timeframe assessment (Arcadis 2014)

References:

Arcadis. 2014. Remedial Timeframe Assessment, PG&E Hinkley Compressor Station, Hinkley, California. June 30.

Haley and Aldrich. 2011. Addendum #3 to the Feasibility Study, Pacific Gas and Electric Company Hinkley Compressor Station, Hinkley, California. September 15.

Table D-3
Implementation Summary 2015-2019 Modeling, RTA Fast Scenario 2 and RTA Slow Scenario 3
Appendix D: Four-Year Remedial Timeframe Assessment Update
Four Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

	RTA Scenarios 2 and 3	Actual Operations (used in Actual Rates Slow Scenario 3B)
Baseline Cr(VI) Distribution	First Quarter 2014	First Quarter 2014
Northern ATU Flow Rates (gpm)	1,500	923
Southern ATU Flow Rates (gpm)	340	390
IRZ Operations		
Flow Rate (gpm)	120	Average 105
Injection Assumptions	Inject across entire Upper Aquifer	Injections focused on deep zone, with shallow zone injections conducted where needed to maintain treatment
Average TOC Injection Concentration (mg/L)	30	40
SCRIA IRZ		
Total Flow Rate	35 to 155, average 130	Average 100
Injection Assumptions	Inject across entire Upper Aquifer	Injections focused on the deep zone in the Deep SCRIA East and throughout the modeled plume in the west
Average TOC Injection Concentration (mg/L)	200	2015-Q1 2017: 50 Q2 2017-2018: 80 Q3 2018-2019: 100
Source Area		
Flow Rate	150-170, average 160	Average 90
Injection Assumptions	Inject across entire Upper Aquifer	Injection intervals varied by location
Average TOC Injection Concentration (mg/L)	200	85

Abbreviations:

ATU = Agricultural Treatment Unit
Cr(VI) = hexavalent chromium
gpm = gallons per minute
IRZ = In Situ Reactive Zone
mg/L = milligrams per liter
SCRIA = South Central Reinjection Area
TOC = total organic carbon

Table D-4
Implementations Summary for Future Modeling
Appendix D: Four-Year Remedial Timeframe Assessment Update
Four Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

	Assumption
Baseline Cr(VI) Distribution	Fourth Quarter 2019
Northern ATU Flow Rates (gpm)	810
Southern ATU Flow Rates (gpm)	270
IRZ Systems	
Flow Rate (gpm)	Average 325
Injection Assumptions	Depth discreet well rotations
Average TOC Injection Concentration (mg/L)	30-100

Abbreviations:

ATU = Agricultural Treatment Unit
 Cr(VI) = hexavalent chromium
 gpm = gallons per minute
 IRZ = In Situ Reactive Zone
 mg/L = milligrams per liter
 TOC = total organic carbon

Table D-5
Updated Model Predicted Percent Area with Cr(VI) Less Than 50 µg/L, December 31, 2025
Appendix D: Four-Year Remedial Timeframe Assessment Update
Four Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Model Layer	Slow Scenario 3B	Updated Scenario 4
Model Layer 1	90% ¹	72% ¹
Model Layer 2	93%	68%
Model Layer 3	97%	87%

Notes:

Percentages calculated as remaining 50-µg/L plume area in comparison to 50-µg/L plume area in the First Quarter of 2014 used in the original RTA (Arcadis 2014).

¹ Assumes 15 acres of dewatered shallow zone remains unsaturated.

Abbreviations:

µg/L = micrograms per liter

RTA = remedial timeframe assessment (Arcadis 2014)

Reference:

Arcadis. 2014. Remedial Timeframe Assessment, PG&E Hinkley Compressor Station, Hinkley, California. June 30.

Table D-6

Summary of Updated Model Estimated Remedial Timeframes to Reach 50 µg/L Across 90 Percent of the Plume
Appendix D: Four-Year Remedial Timeframe Assessment Update
Four Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Model Layer	Slow Scenario 3B	Updated Scenario 4
Model Layer 1	2026 ¹	2033 ¹
Model Layer 2	2025	2031
Model Layer 3	2024	2035

Notes:

Based on 90 percent calculated as remaining 50-µg/L plume area in comparison to 50-µg/L plume area in the First Quarter of 2014 used in the original RTA (Arcadis 2014).

¹ Assumes 15 acres of dewatered shallow zone remains unsaturated.

Abbreviations:

µg/L = micrograms per liter

RTA = remedial timeframe assessment (Arcadis 2014)

Reference:

Arcadis. 2014. Remedial Timeframe Assessment, PG&E Hinkley Compressor Station, Hinkley, California. June 30.

Table D-7

Summary of Updated Model Estimated Remedial Timeframes to Reach 10 µg/L Across 80 Percent of the Plume
Appendix D: Four-Year Remedial Timeframe Assessment Update
Four Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019)
Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California

Model Layer	Slow Scenario 3B	Updated Scenario 4
Model Layer 1	2024 ¹	2034 ¹
Model Layer 2	2031	2048
Model Layer 3	2035	2058

Notes:

Based on 80 percent calculated as remaining 10-µg/L plume area in comparison to 10-µg/L plume area in the First Quarter of 2014 used in the original RTA (Arcadis 2014).

¹ Assumes 15 acres of dewatered shallow zone remains unsaturated.

Abbreviations:

µg/L= micrograms per liter

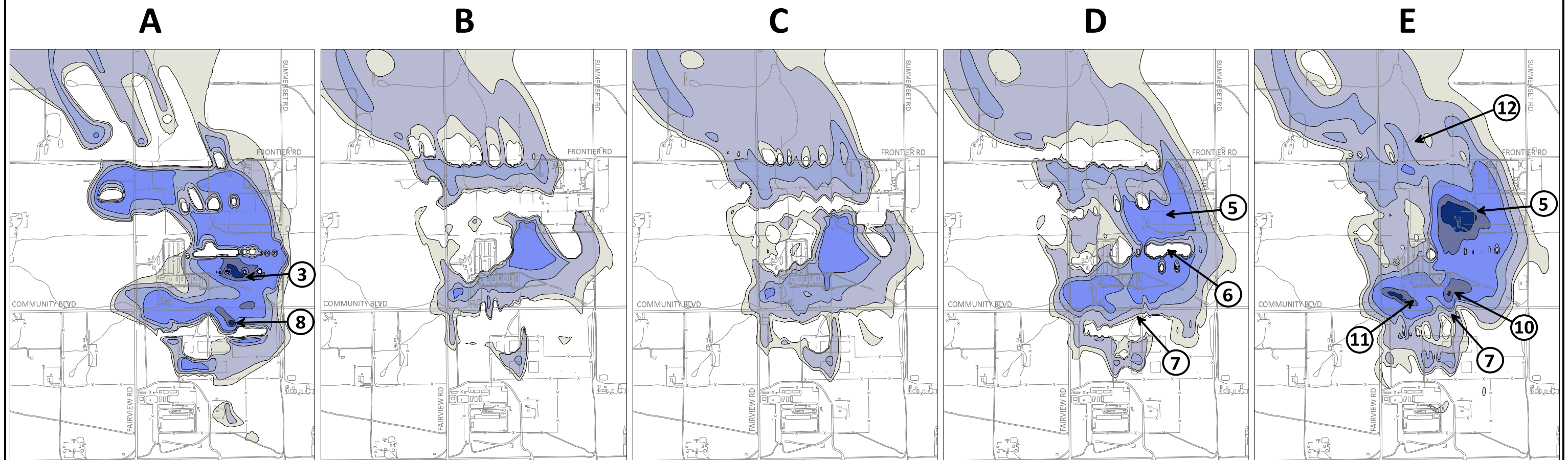
RTA = remedial timeframe assessment (Arcadis 2014)

Reference:

Arcadis. 2014. Remedial Timeframe Assessment, PG&E Hinkley Compressor Station, Hinkley, California. June 30.

FIGURES





**OBSERVED MIDDLE ZONE
OF UPPER AQUIFER
4TH QUARTER 2019**

**RTA FAST SCENARIO 2
4TH QUARTER 2019**

Simplified Operational Assumptions
TOC Threshold = 0.1 mg/L
No Residual Reducing Capacity
Constant Mass Transfer Coefficient

**RTA SLOW SCENARIO 3
4TH QUARTER 2019**

Simplified Operational Assumptions
TOC Threshold = 1.0 mg/L
No Residual Reducing Capacity
Constant Mass Transfer Coefficient

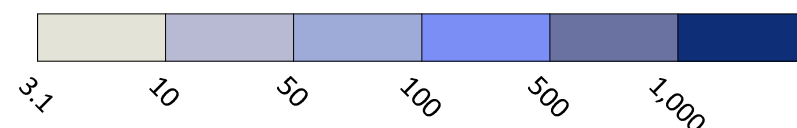
**ACTUAL RATES
SLOW SCENARIO 3B
4TH QUARTER 2019**

Actual Operational Rates and TOC Dosing
TOC Threshold = 1.0 mg/L
2-Year Residual Reducing Capacity
Constant Mass Transfer Coefficient

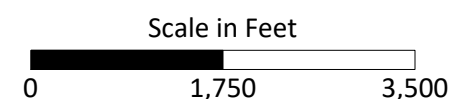
**ACTUAL RATES
UPDATED SCENARIO 4
4TH QUARTER 2019**

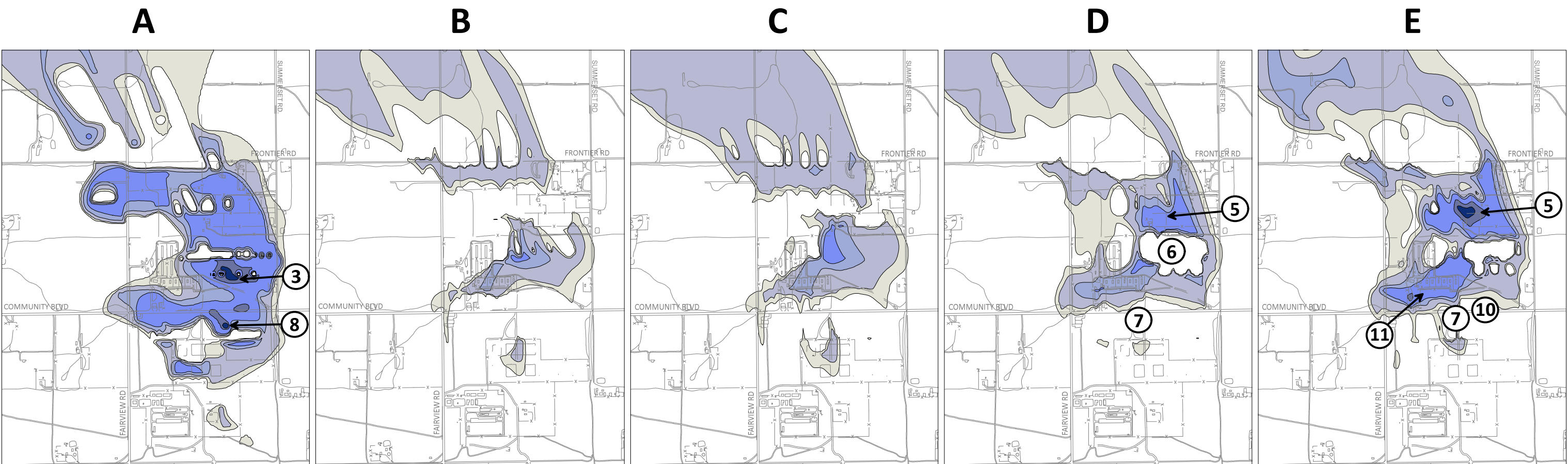
Actual Operational Rates and TOC Dosing
TOC Threshold = 10.0 mg/L
2-Year Residual Reducing Capacity
Adaptive Mass Transfer Coefficient

Hexavalent Chromium Concentrations (µg/L)



NOTES:
µg/L = micrograms per liter
mg/L = milligrams per liter
RTA = Remedial Timeframe Assessment
TOC = Total organic carbon





**OBSERVED LOWER ZONE
OF UPPER AQUIFER
4TH QUARTER 2019**

**RTA FAST SCENARIO 2
4TH QUARTER 2019**

Simplified Operational Assumptions
TOC Threshold = 0.1 mg/L
No Residual Reducing Capacity
Constant Mass Transfer Coefficient

**RTA SLOW SCENARIO 3
4TH QUARTER 2019**

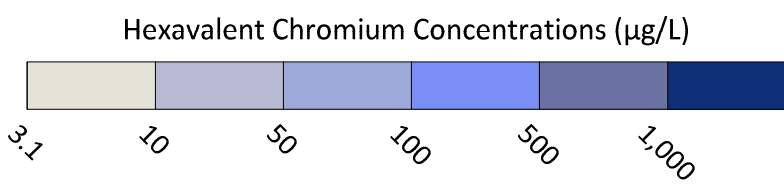
Simplified Operational Assumptions
TOC Threshold = 1.0 mg/L
No Residual Reducing Capacity
Constant Mass Transfer Coefficient

**ACTUAL RATES
SLOW SCENARIO 3B
4TH QUARTER 2019**

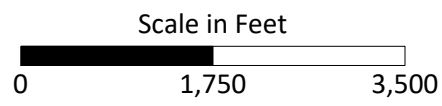
Actual Operational Rates and TOC Dosing
TOC Threshold = 1.0 mg/L
2-Year Residual Reducing Capacity
Constant Mass Transfer Coefficient

**ACTUAL RATES
UPDATED SCENARIO 4
4TH QUARTER 2019**

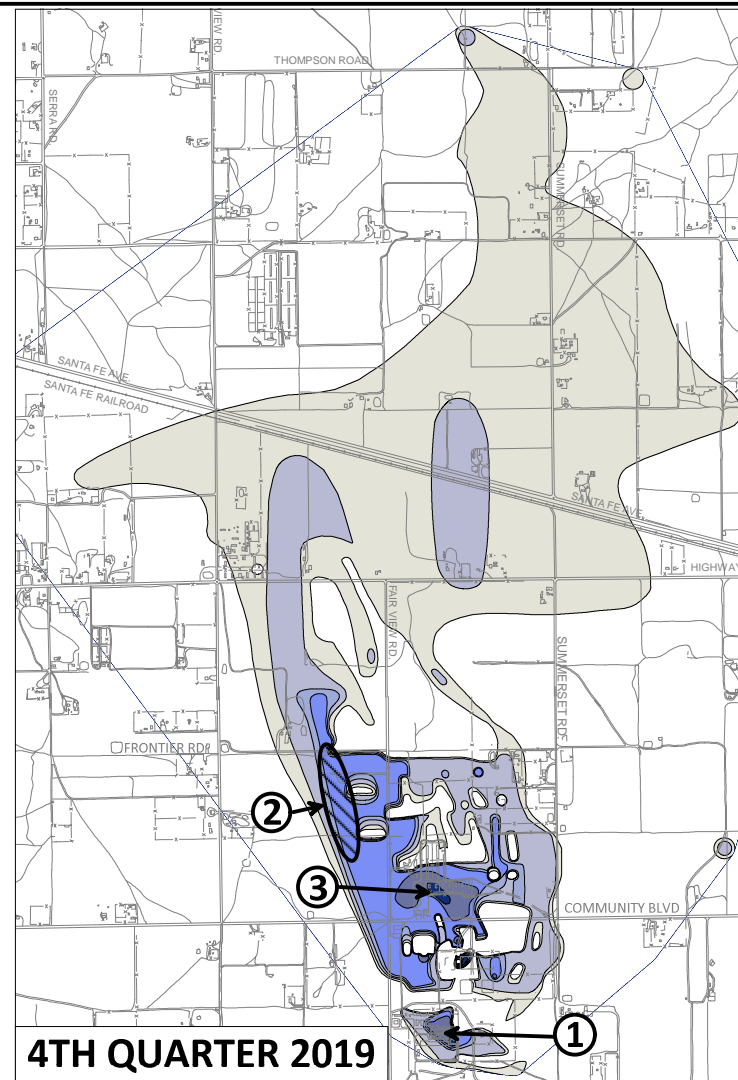
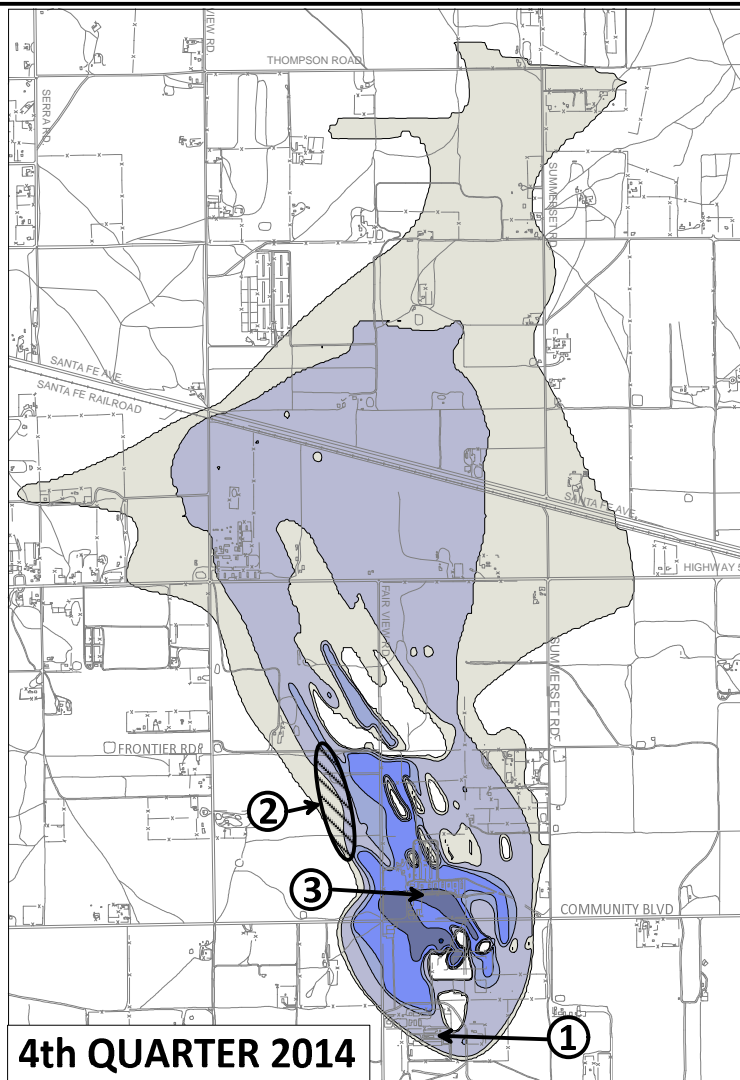
Actual Operational Rates and TOC Dosing
TOC Threshold = 10.0 mg/L
2-Year Residual Reducing Capacity
Adaptive Mass Transfer Coefficient



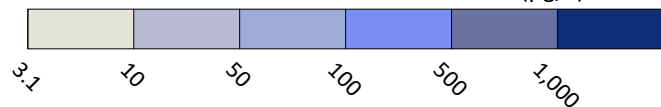
NOTES:
µg/L = micrograms per liter
mg/L = milligrams per liter
RTA = Remedial Timeframe Assessment
TOC = Total organic carbon



PACIFIC GAS AND ELECTRIC COMPANY HINKLEY COMPRESSOR STATION HINKLEY, CALIFORNIA FOUR-YEAR COMPREHENSIVE CLEANUP STATUS AND EFFECTIVENESS REPORT (2016-2019)	
COMPARISON OF MODELING RESULTS TO ACTUAL RESULTS DEEP ZONE OF UPPER AQUIFER - MODEL LAYER 3	
ARCADIS Design & Consultancy for natural and built assets	FIGURE D-3



Hexavalent Chromium Concentrations ($\mu\text{g/L}$)

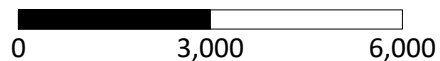


NOTES:

$\mu\text{g/L}$ = micrograms per liter



Scale in Feet

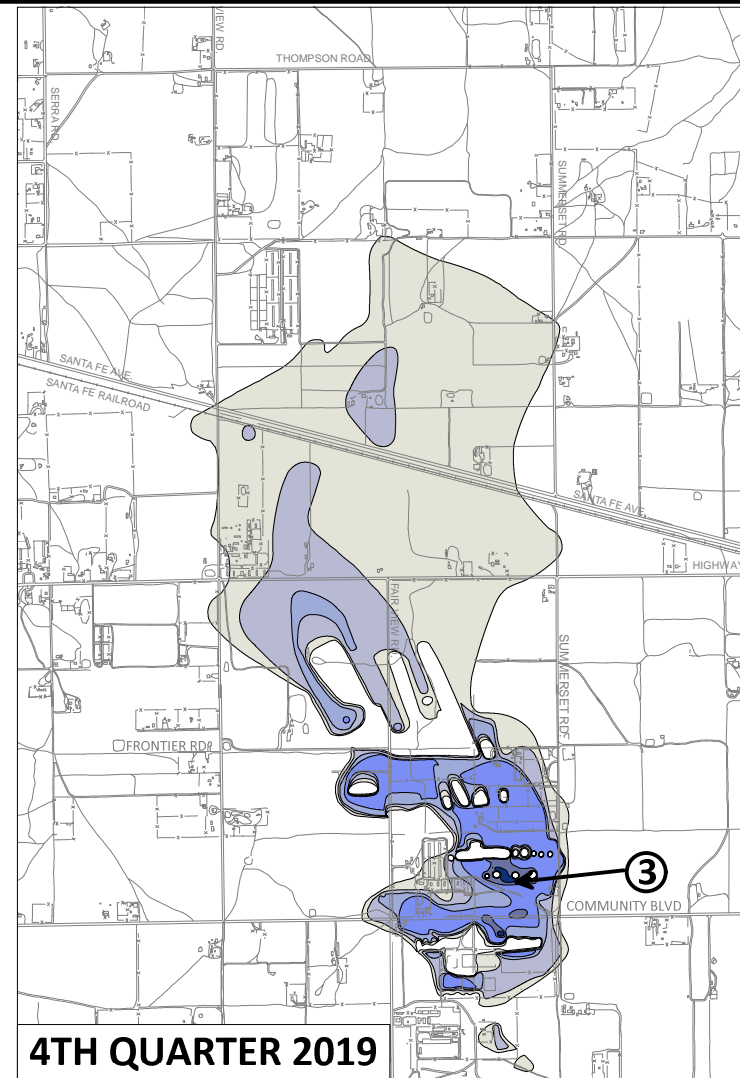
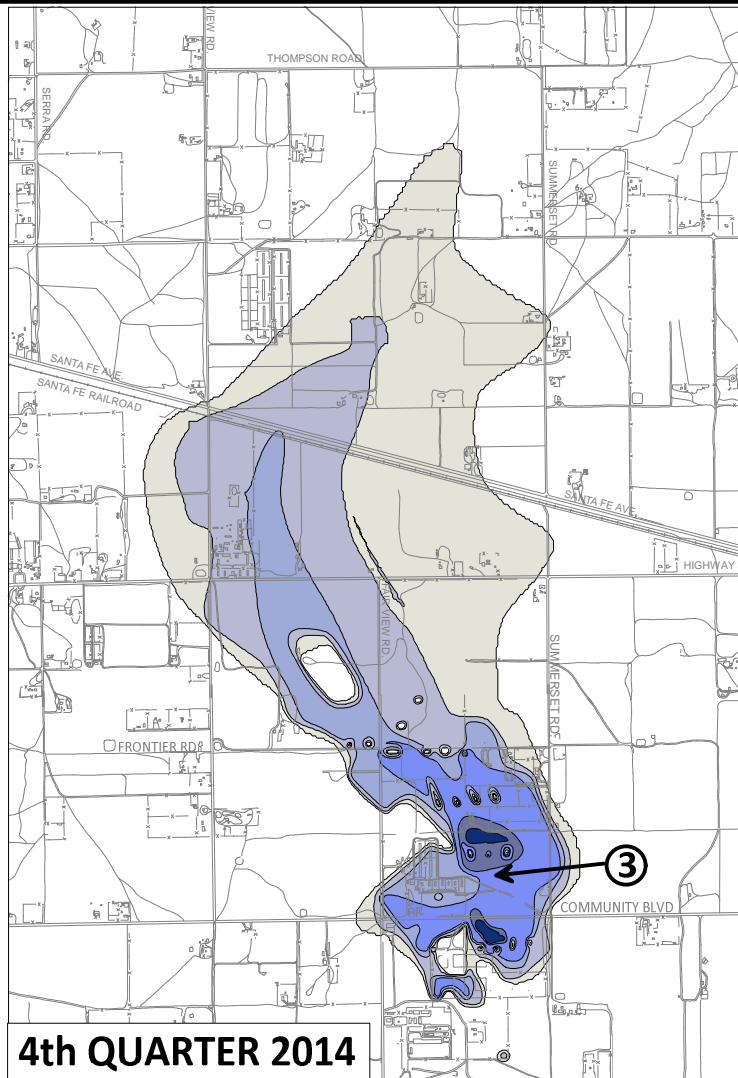


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HINKLEY, CALIFORNIA
FOUR-YEAR COMPREHENSIVE CLEANUP STATUS
AND EFFECTIVENESS REPORT (2016-2019)

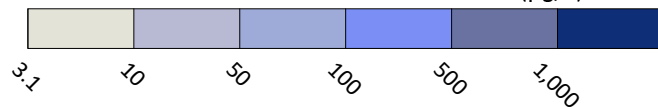
OBSERVED 4TH QUARTER 2014 AND
4TH QUARTER 2019 PLUMES IN SHALLOW
ZONE OF UPPER AQUIFER - MODEL LAYER 1

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FIGURE
D-4



Hexavalent Chromium Concentrations (µg/L)

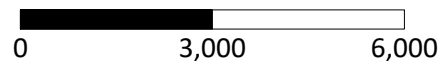


NOTES:

µg/L = micrograms per liter



Scale in Feet



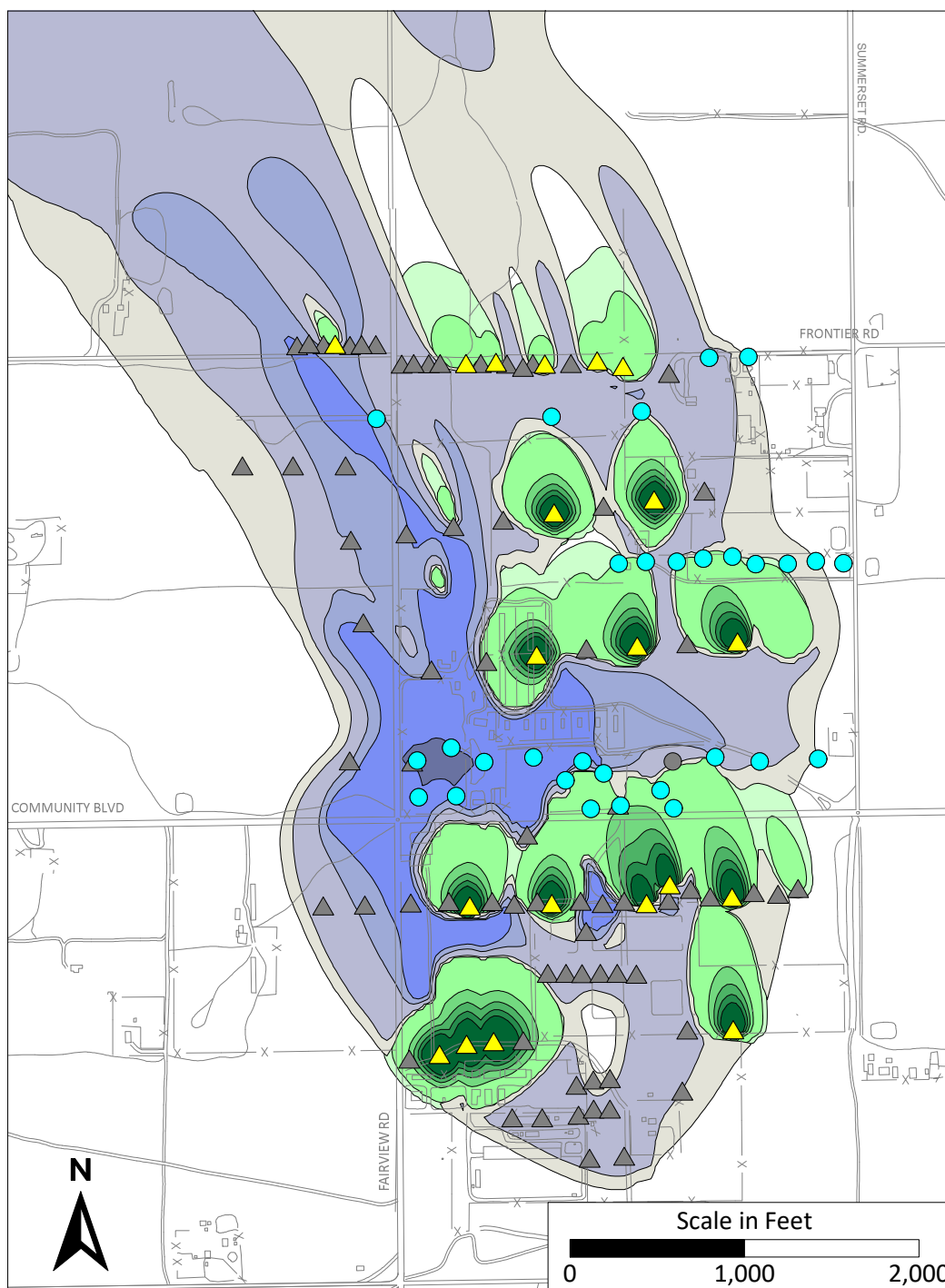
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA
FOUR-YEAR COMPREHENSIVE CLEANUP STATUS
AND EFFECTIVENESS REPORT (2016-2019)

OBSERVED 4TH QUARTER 2014 AND
4TH QUARTER 2019 PLUMES IN DEEP ZONE
OF UPPER AQUIFER - MODEL LAYERS 2 & 3

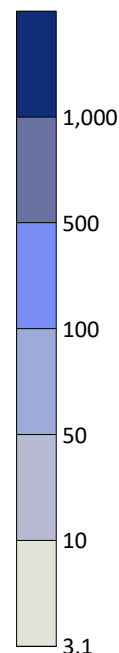
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FIGURE

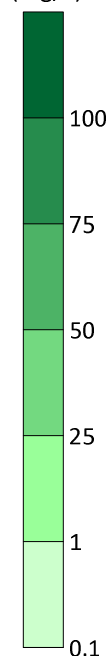
D-5



Hexavalent Chromium
Concentrations
($\mu\text{g/L}$)



Carbon
Concentrations
(mg/L)



RTA SLOW SCENARIO 3 3RD QUARTER 2015

Simplified Operational Assumptions
TOC Threshold = 1.0 mg/L
No Residual Reducing Capacity
Constant Mass Transfer Coefficient

SHALLOW (LAYER 1): 3Q2015 WELLS

- ▲ Active Remediation Injection Well
- Active Remediation Extraction Well
- ▲ Inactive Remediation Injection Well
- Inactive Remediation Extraction Well

NOTES:

$\mu\text{g/L}$ = micrograms per liter

mg/L = milligrams per liter

RTA = Remedial Timeframe Assessment

TOC = Total organic carbon

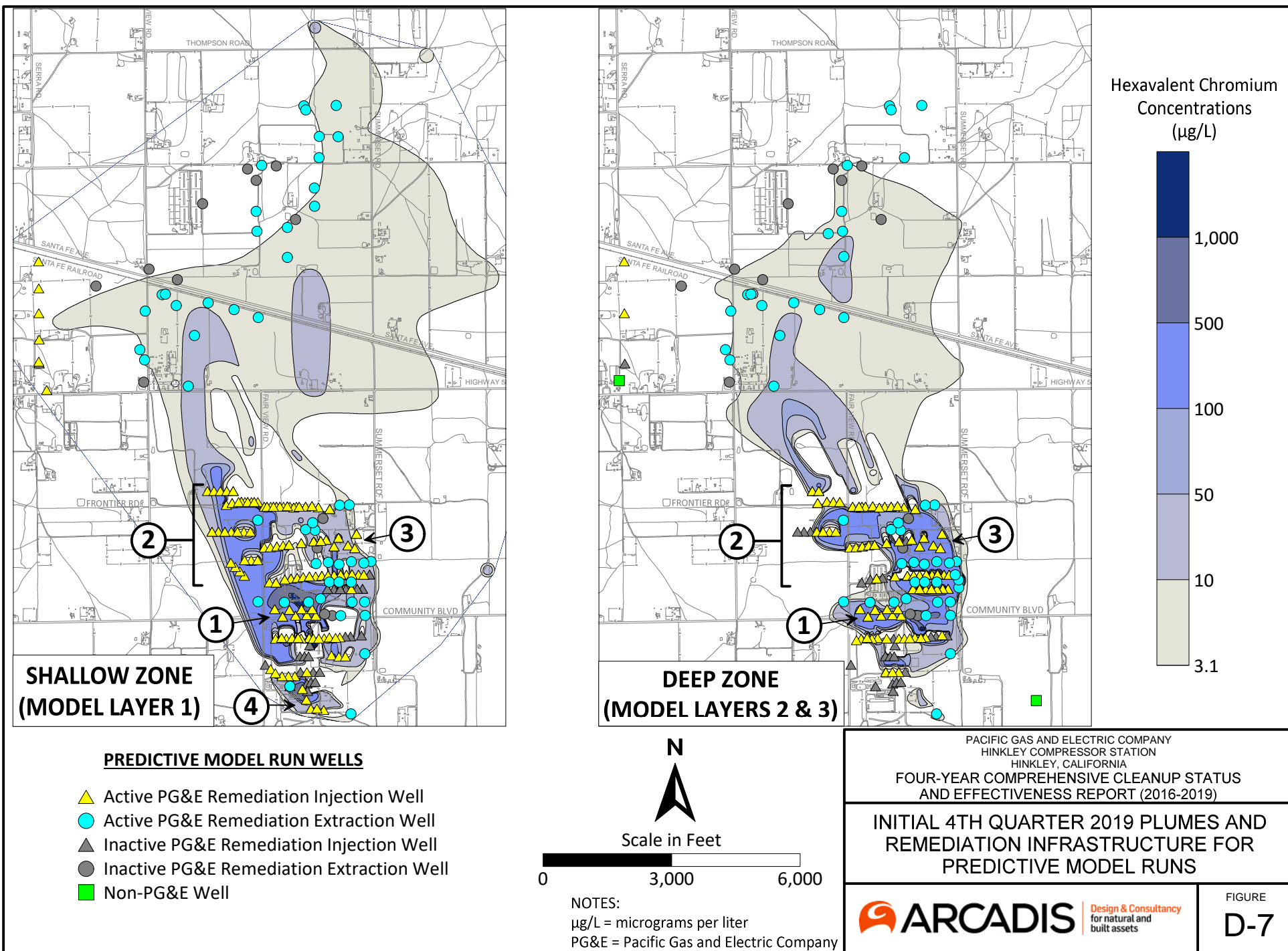
PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
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FOUR-YEAR COMPREHENSIVE CLEANUP STATUS
AND EFFECTIVENESS REPORT (2016-2019)

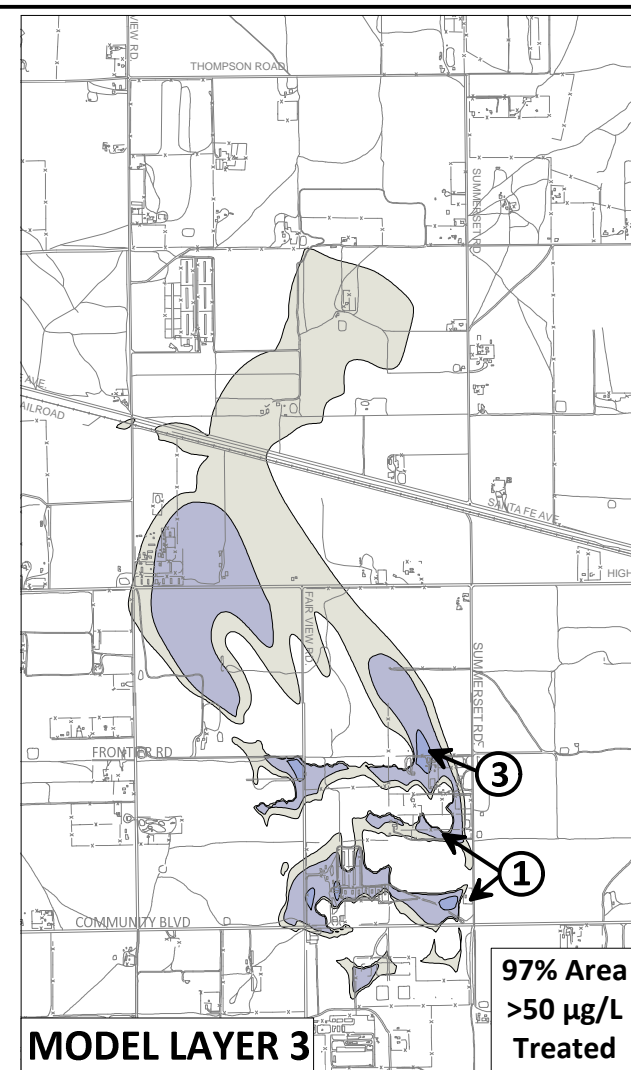
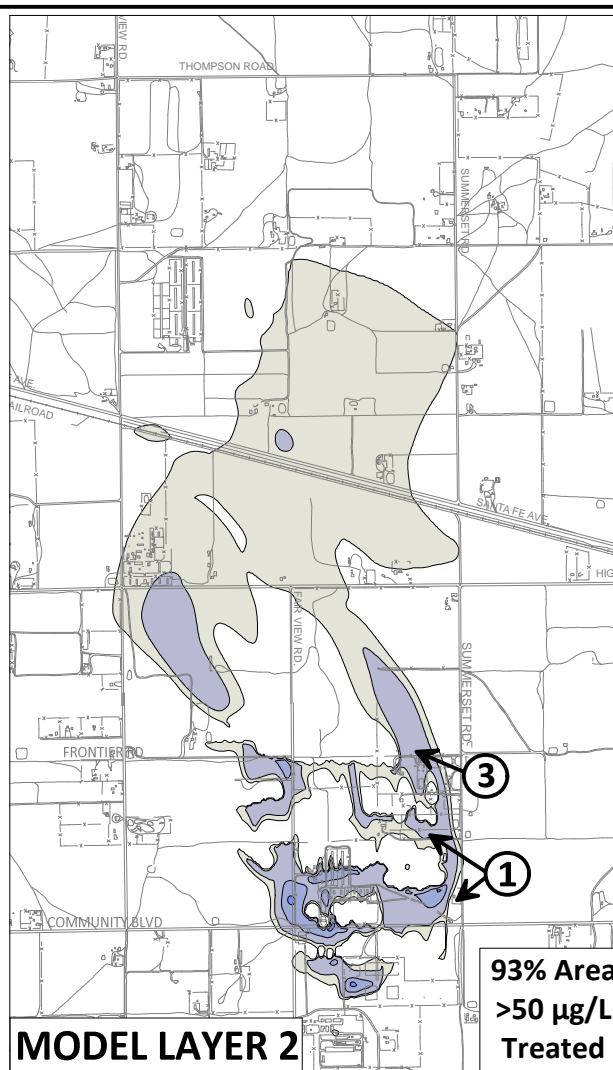
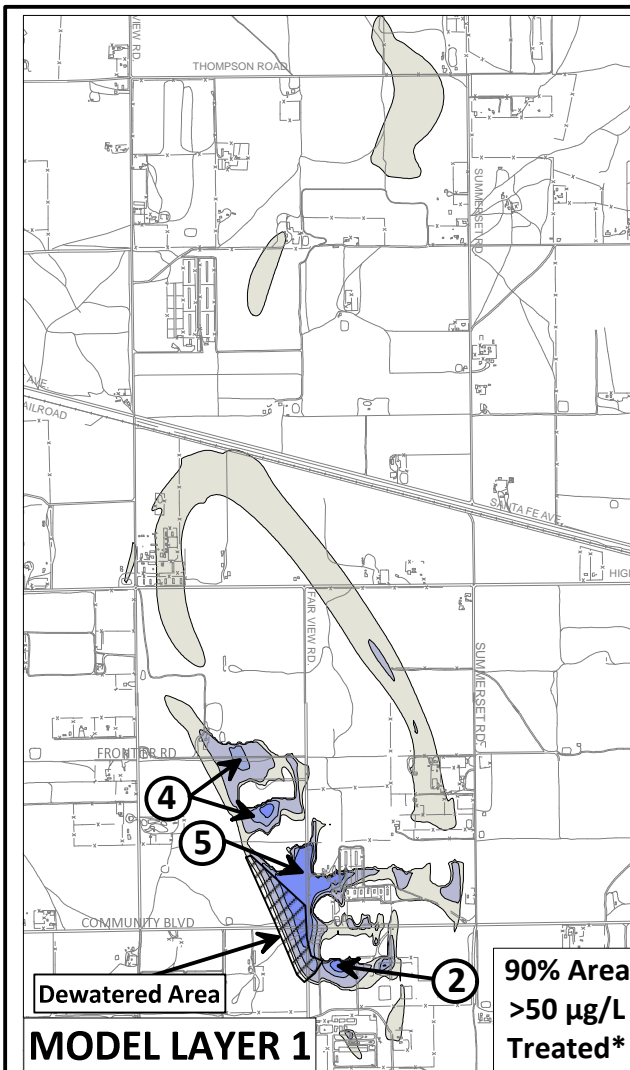
EXAMPLE SIMULATED DOWNGRADIENT ORGANIC CARBON DISTRIBUTION

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FIGURE

D-6





PREDICTED RATES SLOW SCENARIO 3B 4TH QUARTER 2025

Estimated Operational Rates and TOC Dosing

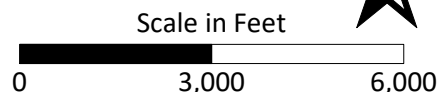
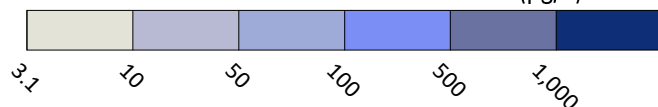
TOC Threshold = 1.0 mg/L

2-Year Residual Reducing Capacity

Constant Mass Transfer Coefficient

*Assumes 15 acres of dewatered shallow zone aquifer remain unsaturated.

Hexavalent Chromium Concentrations (µg/L)



NOTES:

µg/L = micrograms per liter
mg/L = milligrams per liter
TOC = Total organic carbon

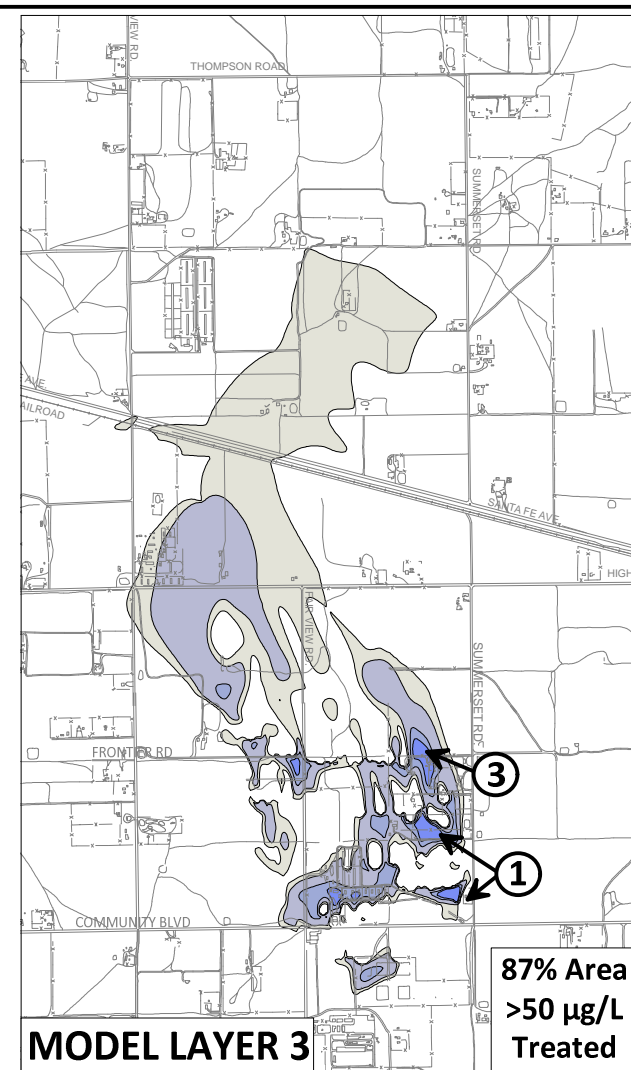
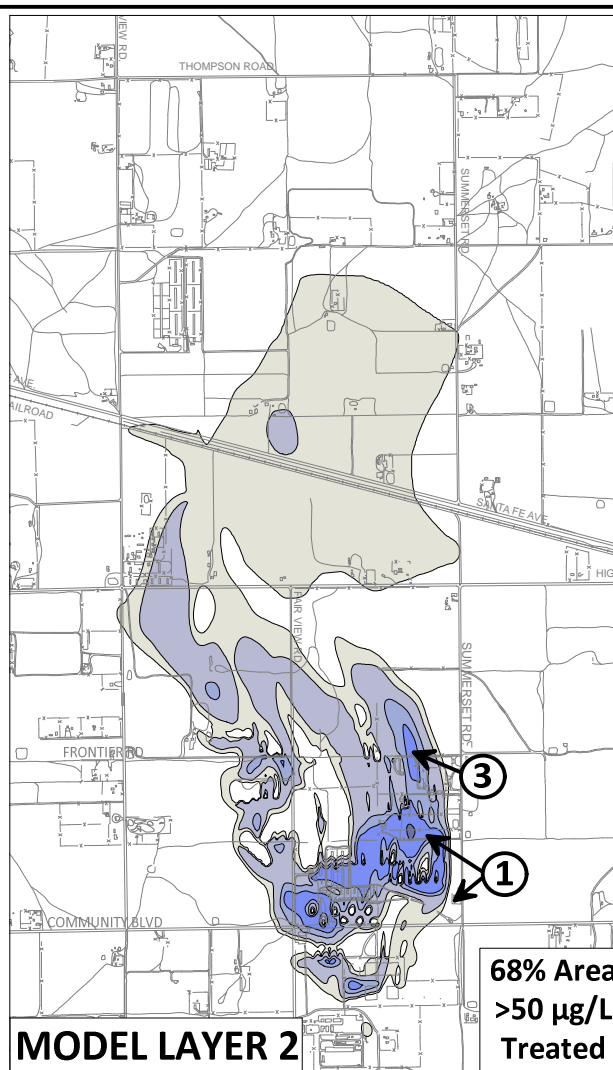
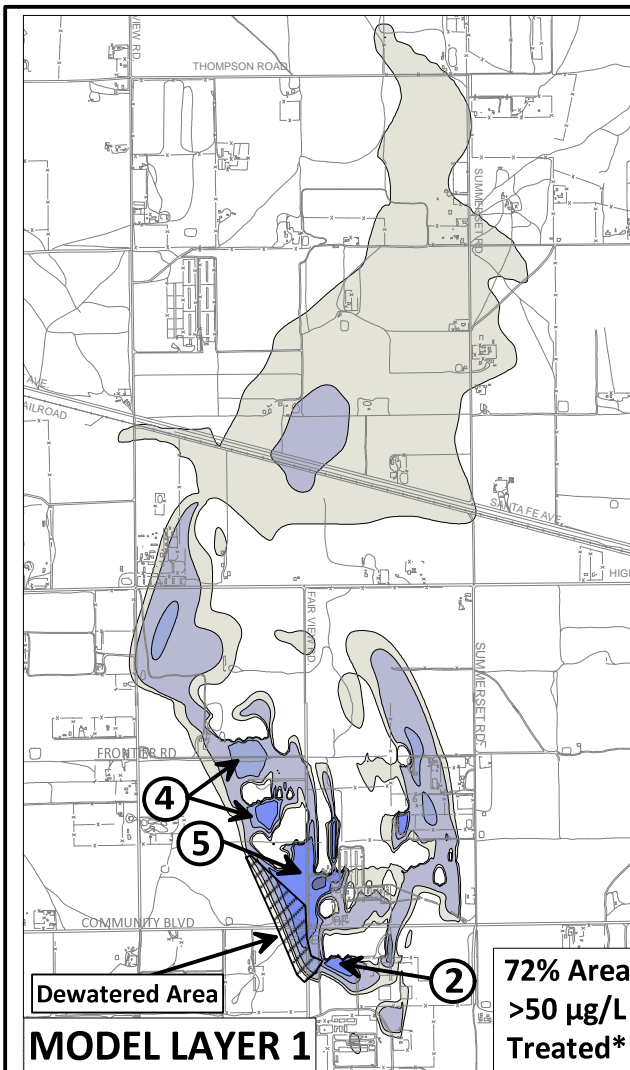


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HINKLEY, CALIFORNIA
FOUR-YEAR COMPREHENSIVE CLEANUP STATUS
AND EFFECTIVENESS REPORT (2016-2019)

2020 UPDATED MODEL PREDICTIONS
SCENARIO 3B, END OF 4TH QUARTER 2025

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FIGURE
D-8



PREDICTED RATES UPDATED SCENARIO 4 4TH QUARTER 2025

Estimated Operational Rates and TOC Dosing

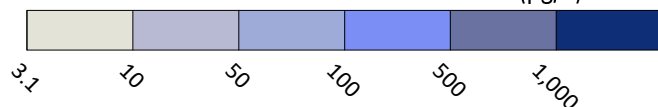
TOC Threshold = 10.0 mg/L

2-Year Residual Reducing Capacity

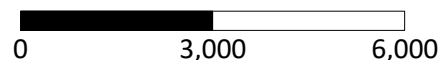
Adaptive Mass Transfer Coefficient

*Assumes 15 acres of dewatered shallow zone aquifer remain unsaturated.

Hexavalent Chromium Concentrations (µg/L)



Scale in Feet



NOTES:

µg/L = micrograms per liter
mg/L = milligrams per liter
TOC = Total organic carbon



PACIFIC GAS AND ELECTRIC COMPANY
HINKLEY COMPRESSOR STATION
HINKLEY, CALIFORNIA
FOUR-YEAR COMPREHENSIVE CLEANUP STATUS
AND EFFECTIVENESS REPORT (2016-2019)

2020 UPDATED MODEL PREDICTIONS
SCENARIO 4, END OF 4TH QUARTER 2025

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FIGURE
D-9

APPENDIX E

Evaluation of Best Available Technologies for Remediation of
Chromium in Groundwater



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From:

Margaret Gentile, PE, PhD

Date:

March 30, 2020

Arcadis Project No.:

RC000699

Subject:

Evaluation of Best Available Technologies for Remediation of Chromium in
Groundwater

INTRODUCTION

The Cleanup and Abatement Order No. R6V-2015-0068, issued on November 4, 2015 (2015 CAO; California Regional Water Quality Control Board, Lahontan Region [Water Board] 2015) requires that the 4-year evaluation report provide research of best available technologies (BATs) that may be available to remediate chromium in groundwater sooner than the target deadlines in the CAO. The feasibility study (FS) for the Pacific Gas and Electric Company (PG&E) Hinkley Compressor Station (the site) recommended that the remedy be composed of in-situ remediation for the plume core, hydraulic containment via groundwater extraction, and treatment by agricultural fields and freshwater injection (Haley and Aldrich 2010). This recommended remedy is being implemented to meet the requirements of the 2015 CAO. The primary benefits of this approach, recognized in the FS, included the speed of re-establishment of groundwater conditions to meet maximum contaminant levels (MCLs) and re-establish beneficial use through in-situ treatment of the plume core, robust containment of the plume through groundwater extraction and freshwater injection, productive use of extracted groundwater through production of agricultural feed crops, and reduction of nitrate impacts from non-PG&E sources through agricultural treatment (Haley and Aldrich 2010).

California BATs are specified for water treatment in the California code. California BATs for hexavalent chromium (Cr[VI]) were developed when the California MCL of 10 micrograms per liter (µg/L) was released on July 1, 2014. The California MCL for Cr(VI) was rescinded on September 11, 2017. Currently, BATs are only available for total chromium (Cr[T]). This memorandum summarizes California BATs and other technologies for ex-situ treatment at the time of the FS (Haley and Aldrich 2010), provides an updated evaluation of available aboveground treatment technologies, and provides an evaluation of whether changes in technology since the time of the FS could be used to expedite the pace of remediation.

EX-SITU TREATMENT TECHNOLOGIES CONSIDERED IN THE FS

The FS considered the four California BATs for Cr(T), including chemical reduction/coagulation/filtration (RCF), reverse osmosis (RO), and ion exchange, both weak base anion exchange (WBA) and strong base anion exchange (SBA) (Haley and Aldrich 2010). The FS also considered technologies other than California BATs, including agricultural treatment and membrane bioreactors (MBfR; Haley and Aldrich 2010). Ex-situ technologies were originally screened for the pump and treat only alternative (Alternative 5) in the FS (Haley and Aldrich 2010) and were further evaluated in response to comments on the FS as a contingency for agricultural treatment, in Feasibility Study Addendum #3 (FS Addendum #3, Haley and Aldrich 2011). The following summarizes the FS analysis of these technologies:

RCF was originally retained for the pump and treat alternative in the 2010 FS (Haley and Aldrich 2010) and was recommended as a potential supporting or contingency ex-situ treatment process for agricultural treatment in the FS Addendum #3 (Haley and Aldrich 2011). This process has been demonstrated to reach required Cr(VI) discharge concentrations without the potential of producing harmful byproducts. RCF does not require a large footprint. Additionally, RCF solid and liquid waste streams were determined to be more manageable than for other ex-situ processes, such as RO and ion exchange. RCF would still require pilot testing before implementation to determine specific process design parameters and implementability constraints.

RO was not retained in the FS as a contingency or supplement for agricultural treatment due to poor implementability (Haley and Aldrich 2010). RO requires elaborate pre-treatment, is energy intensive, and produces a substantial waste stream (brine) that requires offsite transportation and disposal. Pilot testing would be required to better evaluate implementability of this technology. RO also has a high relative capital and annual cost. WBA exchange was recommended as a potential supporting or contingency ex-situ treatment process for agricultural treatment in FS Addendum #3 (Haley and Aldrich 2011). Primary advantages to WBA are general operational simplicity and process components that can be obtained and assembled in a more temporary/modular configuration. The WBA technology also has potential drawbacks, which include the potential concentration of other anions from the influent stream and potential formaldehyde and N-nitrosodimethylamine formation in effluent and spent resin disposal. Pilot testing may be required to better evaluate the implementability of this technology.

MBfR and SBA exchange were not retained in the FS because these technologies did not sufficiently demonstrate technical effectiveness and implementability (Haley and Aldrich 2010). SBA was not anticipated to be effective at the site given the competition by sulfate present in site groundwater and the potential for chromatographic peaking (for example, of nitrate present in site groundwater).

BEST AVAILABLE TECHNOLOGIES CONSIDERED AFTER THE FS

Since the FS (Haley and Aldrich 2010), PG&E pursued pilot testing of an additional bioreactor technology as a contingency or alternate to agricultural treatment. The pilot test was conducted at the site between January 2015 and September 2016, as summarized in the Bioreactor Pilot Test Completion Report (Geosyntec 2017). The bioreactor pilot test evaluated a two-stage biological treatment system for removal of Cr(VI) from groundwater. During operations, the bioreactor treated approximately 5,404,000 gallons of groundwater over 17 months. As summarized in the report, this treatment technology has been shown to be effective at removing Cr(VI) from groundwater to less than interim background levels, under a variety of operating conditions. Based on the favorable results of the pilot test, the bioreactor is currently considered as a contingency technology for the existing agricultural treatment units (ATUs) at the site.

Additional technology development was undertaken in the industry during the MCL development period for Cr(VI) in California (Blute et al. 2013). Reduction/filtration via stannous chloride (RF-Sn(II)), which uses stannous chloride as the reductant/coagulant. The RF-Sn(II) technology has a smaller profile, reduced complexity, and reduced waste compared to RCF. However, the ability of the RF-Sn(II) technology to reach low single digit part per billion concentrations is dependent on influent concentrations and may not reach goals for all situations in which it would be used at the site. This technology is unproven in application compared to other options.

SUMMARY

Since the time of the FS development (Haley and Aldrich 2010), the development of two additional treatment technologies have progressed with a bioreactor pilot test conducted at the site and industry development of RF-Sn(II). Although these technologies and other technologies previously evaluated are effective alternatives for aboveground treatment of Cr(VI), these options do not change the balance of criteria used in recommending the remedy in the FS. As detailed throughout the main text of the Four-Year Comprehensive Cleanup Status and Effectiveness Report (2016 to 2019), the pace of remediation in response to in-situ injections and groundwater extraction is a function of the hydrogeology of the subsurface. This pace of cleanup would not be enhanced through the application of an alternative ex-situ treatment technology. Continuing to operate the ATUs for beneficial use of extracted water and chromium treatment continues to also result in a reduction of legacy nitrate impacts to groundwater. This continues to validate the selection of ATUs as the treatment of extracted groundwater. Based on this evaluation, the combination of the current technologies of in-situ treatment, groundwater extraction, and freshwater injection continues to provide an expeditious approach to achieving the goals stated within the 2015 CAO (Water Board 2015).

REFERENCES

- Blute, Nicole, Xueying Wu, Katie Porter, Gereg Imamura, and Michael J. McGuire. 2013. "Hexavalent Chromium Removal Research Supplemental Project Report." Research Managed by City of Glendale, California Department of Water and Power, Report Prepared by Hazen and Sawyer and Arcadis U.S/Malcom Pirnie.
- Geosyntec. 2017. Bioreactor Pilot Test Completion Report, Pacific Gas and Electric Company, Hinkley Compressor Station, Hinkley, California, California Regional Water Quality Control Board, Lahontan Region Order No. R6V-2008-0014 (Waste Discharge Identification No. 6B369107001). April 19.
- Haley and Aldrich. 2010. Feasibility Study, Pacific Gas and Electric Company Hinkley Compressor Station, Hinkley, California. August 30.
- Haley and Aldrich. 2011. Addendum #3 to the Feasibility Study, Pacific Gas and Electric Company Hinkley Compressor Station, Hinkley, California. September 15.
- Water Board. 2015. Cleanup and Abatement Order No. R6V-2015-0068 WDID No. 6B369107001 Requiring Pacific Gas and Electric Company to Clean Up and Abate Waste Discharges of Total and Hexavalent Chromium to the Groundwaters of the Mojave Hydrologic Unit. November 4.

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